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MANAGEMENT HANDBOOK

To Aid Emergency Expansion of

Dehydration Facilities for Vegetables and Fruits

VOLUME II

CABBAGE DEHYDRATION PLANT

A Phase II Preparedness Study

Prepared at the Request of
Office of the Quartermaster General
Department of the Army
Washington, D. C.

By

Western Regional Research Laboratory
Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
U. S. Department of Agriculture

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CHAPTER I

BASIC ASSUMPTIONS

Foreword

The planning of a dehydration plant meeting national emergency needs should take full cognizance of the information and suggestions given in Volume I of this Handbook. This set of plans for a cabbage dehydration plant is based upon the principles set forth in that portion of the Handbook.

Product Desired

The plant covered by this section of the Handbook is designed to produce dehydrated cabbage shreds in accordance with the Military Specification "Cabbage, Dehydrated" (MIL-C-826) dated 27 July 1949.

Bases for Operations, Facilities, and Cost Estimates

A. Location of Plant

Inasmuch as most of the cabbage dehydration during World War II and subsequently for commercial markets has been done in southern and central California, these estimates are based on a plant located in California. This area also has been used as a basis because of the nearly year-round operation that is possible there. The general plan, design, and operations are applicable, however, to plants located in other areas.

B. Operating Basis

Design and cost estimates are based upon an operation of three 8-hour shifts per day, six days a week, and 250 operating days a year. A longer period of operation might be possible, however, under very favorable circumstances of raw material supply. All labor costs are based on regular union rates for 1951 in central California. The labor rates used in this set of plans are as follows:

Class Labor	Hourly Rate
1	$1.90
2	1.73
3	1.55
4	1.42
5	1.34
6	1.18

C. Raw Commodity Used

In line with successful commercial experience, the varieties of cabbage most likely to be used for dehydration are Glory of Enkhuizen and Copenhagen Market. If other varieties are used, the shrinkage ratios and production costs may be different than indicated in this Handbook.

It is assumed that the cabbage will be obtained directly from the growers under contract. Field run material will be processed without grading at the plant; any undesirable cabbage will be eliminated by grading in the field. Only the amount of cabbage necessary to insure continuous and efficient operation of the plant will be stored.

Provision has been made in the cost estimates for raw cabbage at prices ranging from $10 to $40 a ton delivered in bulk at the plant.

D. Plant Capacity and Yields

This plant has been designed to process 100 tons of raw cabbage per day. It is assumed that the preparation line will operate 20 hours a day and have a nominal capacity of 5 tons of raw cabbage per hour. The dehydration tunnels and bins will operate 24 hours per day to dry the material prepared in 20 hours. The packaging line will operate 20 hours per day.

The over-all shrinkage ratio for this plant is assumed to be 20 : 1. Ratios as low as 17 : 1 and as high as 25 : 1 are occasionally experienced; and under good operating conditions and with satisfactory raw material, the ratio should average 20 : 1. On the basis of a 20 : 1 shrinkage ratio, the output would be 10,000 pounds of dehydrated product a day from the 200,000 pounds of raw material entering the processing line.

It is further assumed that the plant is operated in such a manner that the formation of "fines" would not be in excess of that tolerated by the Military Specification (MIL-C-826).

E. Storage Space

Storage space is indicated in the plant plans for approximately a 24-hour supply of raw cabbage. This storage area could be expanded readily, but it would be undesirable in most instances to store cabbage longer than 24 hours. Space also has been provided for storage of a 30-day production of packaged and cased dehydrated cabbage shreds plus a 10-day supply of empty cans and cases, or any desired combination of these items.

F. Waste Disposal

It is assumed that the cabbage trimmings, about 25 tons per day, will be hauled away by farmers, for stockfeed, at no cost to the plant.

CHAPTER II

SUPPLY OF RAW CABBAGE

Characteristics Desired in Raw Cabbage to be Dehydrated

The military specification (Cabbage, Dehydrated, MIL-C-826, dated July 1949) requires that the fresh cabbage to be dehydrated shall be clean, sound, mature heads of good cooking quality. Danish, Domestic Pointed, Savoy, or other green varieties are preferred. Red varieties are not acceptable. The cabbage must be U.S. No. 1 Grade in accordance with Specification HHH-C-26 (except for size). U.S. No. 1 shall consist of heads of cabbage of one variety or similar varietal characteristics , which are of reasonable solidity, and are not withered, puffy, or burst, and which are free from soft rot, seedstems, and from damage caused by discoloration, freezing, disease, insects or mechanical or other means. Stems shall be cut so that they do not extend more than one-half inch beyond the point of attachment of the outermost leaves. Unless otherwise specified, each head shall be well trimmed. Not more than a total of 10 percent (by weight) of the heads in any lot may fail to meet the requirements of this grade, but not more than one-fifth of this amount, or two percent, shall be allowed for soft decay. In addition, not more than 10 percent (by weight) may not meet the requirements as to number of wrapper leaves.

Cabbage to be dehydrated should be of mild flavor, sometimes designated as "sweet", as contrasted with the sharp or slightly bitter flavor of some varieties. It is generally believed that the strong flavors in cabbage become more pronounced with overmaturity, and that cultural practices ordinarily do not influence flavor.

Other desired characteristics in cabbage for dehydration are: maximum vitamin content; deep green color; uniform maturity; straight cores of minimum size; and close-fitting protective wrapper leaves.

It is desirable that cabbage for dehydration be harvested at the maturity that is optimum for market or for shipping. In a normal harvesting season there is usually a latitude of ten days to two weeks during which the first cutting may be made without loss of quality.

From the standpoint of both the grower and the dehydrator, the larger the heads of cabbage, the lower will be the labor cost. To obtain optimum nutritional value and appearance in the dehydrated product, however, it is desirable to use cabbage grown to medium market size -- approximately three to four pounds in weight and six to eight inches in diameter. This size is not too small for economical handling and gives a relatively high amount of green leaves per pound of commodity. Table I shows volume and surface area relationships for various sizes of cabbage.

The shape of cabbage for dehydration is not of material importance except that pointed types are more likely to be damaged in shipping and handling and have less market demand.

As sought in all commodities to be dehydrated, it is desired that cabbage for dehydration have a high solids content. The higher the solids content the higher the yield, and the lower (ordinarily) will be the cost per pound of dehydrated end-product. Under proper cultural practices, cabbage attains optimum solids content at maturity and at this stage is reasonably firm to fairly hard.

Suitable Dehydration Varieties and Commercial Production Data

Current military specifications prefer Danish, Domestic Pointed, or Savoy varieties to be the source of raw material for dehydrated cabbage. According to Dr. J. E. Knott, Professor of Truck Crops, University of California, the term "Danish" (in general) applies to solid-heading, more or less round, slow-maturing varieties which generally may be stored. This would mean primarily Danish Ballhead and Hollander.

Dr. Knott also reports that "Domestic" means reasonably firm heads, but not as compact as Danish. The leaves are not as smooth and do not overlap as much in the head, so this includes most of the other green varieties, except the pointed and Savoy ones.

For the production of the best quality dehydrated cabbage, "Domestic" varieties are preferred because: (1) they have more green leaves, (2) they have higher vitamin content, and (3) they are generally of sweeter flavor (the slower growing Danish types tend to become slightly bitter or strong at maturity).

During World War II most of the cabbage dehydrated was of either the Copenhagen Market or Glory of Enkhuizen varieties, both of these being classified as Domestic. With proper cultural practices and careful timing of harvesting, these two varieties are very acceptable raw material. Both varieties will give good to excellent yields per acre; both are well known to growers in the present and expansible major areas of commercial production. Either variety can be sold for shipping or local market in the event production exceeds dehydrator capacity.

Green varieties such as Savoy are very desirable from the standpoint of nutritional qualities. It is certain, however, that the cost of producing and dehydrating the Savoy varieties would be higher than for the varieties usually dehydrated. The yield per acre of Savoy cabbage is much lower than others commonly grown, and the contract price would have to be correspondingly higher to assure the same net return per acre to the grower as he can get, for example, from Copenhagen Market cabbage. Savoy varieties are not commonly grown in sizable quantity in the principal cabbage producing areas. Furthermore, it would not be possible to secure sufficient seed for their immediate planting on the scale needed for a wartime emergency. Unless sales prices reflect the higher costs involved in dehydrating Savoy varieties, dehydrators will doubtless operate largely on Copenhagen Market and Glory of Enkhuizen.

The principal characteristics of the major varieties of cabbage grown commercially in the United States are summarized in Table II.

Production, yield, and price data for the principal cabbage producing States are shown in Table III.

Procurement Problems 1/

A. Supply of Cabbage Seed

Should the vegetable seed industry of the United States be suddenly confronted again with a substantial increase in the demand for cabbage seed of one or two

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1/ As over 90% of the dehydrated cabbage procured during World War II came from California, the major experience with procurement problems occurred in that State. Therefore these discussions of cultural requirements, harvesting, and other procurement problems apply especially to California conditions.

varieties, the available supply would soon become exhausted. For example, during the early years of World War II, difficulty was experienced in obtaining sufficient supplies of Copenhagen Market and of Glory of Enkhuizen cabbage seed. As soon as the immediate and probable future potential demands were known, the seed companies increased seed production to the extent that adequate supplies were available. This supply, however, became available two years later. It must be realized that production yields of vegetable seeds are subject to great variations, the same as yields of most crops. For this reason, and also because of the possible immediate action needed in case of a national emergency, dehydrator operators should investigate seed supplies and should assure themselves of needed supplies at the earliest possible time.

Approximately four ounces of cabbage seed are required per acre of field crop when the seed is planted in beds and the young plants subsequently transplanted to the field. This is the practice in the important Los Angeles growing area where the high value of land makes it desirable to shorten the time in which a given field is devoted to the crop. In other California areas commercial planting is usually by direct seeding. This "direct seeding" practice saves the time and labor required for transplanting, but requires 3 to 4 pounds of seed per acre, i.e., approximately 12 to 16 times as much seed as for the bed-planting method.

Table IV gives the production of cabbage seed according to principal varieties during the period 1948-1951. It may be assumed, that at least a substantial portion of the 1951 production of varieties suitable for dehydration could be utilized to meet national emergency needs arising in 1952 by diverting the seed normally used for market cabbage to the production of cabbage for dehydration.

B. Soil, Fertilizer, and Other Cultural Requirements

Cabbage can be grown successfully on a rather wide range of soil types. Preferred types are loams, and less desired types are the heavy clay and sandy types. Like most crops, cabbage is sensitive to alkali, and soils with relatively high alkali content should be avoided. Cabbage requires considerable water for good growth. Land to be planted should be of uniform slope to facilitate irrigation and drainage; ample growing-season rainfall or a plentiful supply of water for irrigation is essential.

A growing crop of cabbage needs a relatively large quantity of plant elements, particularly nitrogen, phosphorous, and potassium. Unless the grower knows from previous experience that the soil which is to be planted to cabbage has adequate reserves of these elements, plans for growing the crop should include the application of liberal amounts of one, two, or all three of these plant elements. For example, under most California conditions, an early application (side dressed or broadcast before planting) should be made, and another application should be made when the plants are approximately half-grown. From 500 to 1,000 pounds of chemical fertilizers are often applied per acre. Some growers apply, as the first application, a "16-20-0" mixture 2/, and then apply a fertilizer containing only nitrogen in the last application.

Most of the larger acreages of cabbage grown in California are grown by "direct seeding" in the field, using from 3 to 4 pounds of seed per acre and planting two rows on raised beds with centers about 42 inches apart. When the seedlings are two or three inches in height, the plants are thinned to desired distances -- usually twelve to fourteen inches apart, but varying according to soil fertility, plant variety, market

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2/ Nitrogen content calculated as 16% elemental nitrogen; phosphorous content calculated as 20% phosphorous pentoxide; potassium content calculated as potassium oxide (none in this formula).

demand, and preference of the grower.

As the young seedlings emerge, dusting with D.D.T. or other insecticide is frequently necessary to control various insects. Birds are occasionally troublesome at this time also, and some control is necessary.

During the growth period, vigilance must be maintained particularly against thrips, aphis, or cabbage worms; if even slight infestation is found, immediate dusting or spraying should be done for control. Local insecticide dealers and Extension Service agencies should be consulted as to the kinds and amounts of insecticides to apply.

Growers and dehydrators starting cabbage production activities should assure themselves that adequate insecticides are available; a field of cabbage will soon become worthless when badly infested with aphis or cabbage worms. For instance, during World War II nicotine sulphate was extremely difficult to obtain, and at that time it was about the only effective control for aphis. Since World War II many new, effective insecticides have been made commercially available.

C. Harvesting and Transporting of Cabbage

The harvest period of cabbage maturing in relatively cool weather is less critical than for cabbage maturing during a warm period or season.

Harvesting of a field in a warm season is often accomplished in one cutting. Harvesting is started when perhaps 80% of the heads reach suitable maturity, so that in the few days it usually takes to cut over a field, the last of the field to be harvested may be slightly over-mature. Although both yield and quality of cabbage may be reduced somewhat when the one-cutting method is used, harvesting labor is decreased and the total time from planting to completion of harvest is less. This latter point may be important where several crops per year are being grown on the land.

During World War II a substantial amount of the cabbage for dehydration was harvested as follows: A field crew of six or eight men cut the heads and placed them in windrows with sufficient distance apart for the hauling truck to pass through. After cutting had proceeded for a time, the truck was driven down the rows and the heads were thrown into the truck. With average yields, a crew of six cut and loaded from 30 to 40 tons per day. Close supervision of field crews was necessary to see that unacceptable heads were rejected (seeders, broken heads, etc.) and that the stems were cut at the proper place so that two or three wrapper leaves remained. Generally only one cutting was made; but two cuttings were found advantageous in some production areas.

Harvesting methods differ in different districts. In the Imperial and Salinas areas of California most of the cabbage for dehydration in World War II was harvested with the same equipment used to harvest market cabbage. This method involves the use of light tractors and four-wheel trailers or wagons into which the cutters throw the cabbage as it is cut. Usually six or eight men cut on both sides and in the rear of the trailer, as the tractor draws it through the field. When the trailer is loaded the tractor hauls it to the edge of the field where another crew of about four men transfers by hand the trailer load to a large semi-trailer or truck-and-trailer. This method of harvesting is reported to cost around two to three dollars per ton in recent years. The advantages of this method are:

(1) Three cuttings are usually done which gives better assurance of proper control of maturity

(2) Maximum yield of proper quality commodity

The disadvantages of this method are:

(1) More costly

(2) More manpower required

(3) More mechanical damage due to handling twice rather than once

After being cut, cabbage should be handled without delays. No more than a few hours should elapse before it is loaded because the outside leaves bleach rapidly if the cabbage is left in the sun for any length of time. Cutting in the evenings and loading the trucks in the evenings and nights will help minimize bleaching. The loaded cabbage should be hauled to the processing plant without delay and should be processed as soon as possible. Close scheduling of truck loadings and arrivals must be made to balance the needs of the plant. Dependable truck drivers and mechanically sound trucks are of critical importance.

Cabbage must be protected from the sun and wind. The cabbage should be ke in a cool place, but protected from frost or freezing.

Table V and Figure 1 give planting and harvesting seasons for the principal cabbage producing States.

Part or all of the supply of raw commodity may be grown some distance from the dehydrator. This will increase the cost for transportation, and may fail to provide the continuous supply necessary for efficient plant operation. During World War much of the cabbage successfully dehydrated was hauled 500 to 600 miles; these long hauls were justified because of the war-time need for extending the processing season of some dehydration plants.

A cabbage dehydrator located in southern California could perhaps operate the year around under optimum conditions. Market cabbage is available every month of the year in the Los Angeles area. The dehydrator likely would obtain the raw commodity from this area during the spring months when harvesting is heavy, prices are favorable, and the quality is at optimum. For the remaining months of the year, cabbage would be available to this plant from more distant locations. For a plant located in Orange County, California, the table below indicates the cabbage-supplying areas, the seasons of availability, and the distances and costs involved in hauling. Obviously, the Phoenix and Salinas areas have been used only when the need for raw cabbage was urgent, because of the high hauling costs.

Area	Period of Availability of Cabbage in Quantity	Approximate Distance (Miles)	Approximate Hauling Cost Per Ton (Bulk)
Phoenix, Arizona	November to April	400	$8
Imperial, Calif.	January to March	200	6
Orange & Los Angeles Counties	April and May	(local)	2
Oxnard, Calif.	April until Fall	100	4
Santa Maria, Calif.	April until Fall	200	6
Salinas, Calif.	May to December	400	8

Unpredictable variations in weather conditions would probably make it very difficult to operate the dehydration plant a full 12 months every year. In spite of the fact that contracts may be placed with planting times specified to produce cabbage throughout the year, unusual weather periods may bring many fields to maturity considerably ahead of or behind schedule. A cabbage dehydrator, therefore, may be wise not to count on an operation longer than 250 days.

D. Storing Raw Cabbage

There is little deterioration in cabbage in the first 72 hours after cutting, provided air circulation is adequate and temperatures are not high. Although cabbage can be held considerable lengths of time under cold storage, the additional costs (crating, moving the product into and out of storage, and storage operations) prohibit storage of cabbage for ordinary dehydration operations.

Usual cabbage holding facilities are slatted bins or boxes; the floor on which the bins or boxes sit also should be slatted for improved ventilation. Cabbage may be stored for a short period of time (only a few hours) on a concrete floor provided that (1) the cabbage is cool upon arrival and (2) the storage area is sheltered and well ventilated.

Another method of one successful World War II operator was to use a large number of small trailers as temporary storage bins. The cabbage was unloaded from large field trucks or rail cars into several of these small trailers holding perhaps four or five tons each. These trailers were unloaded in succession as the cabbage was used by the plant. By this method, there was no delay or demurrage of the large trucks or rail cars, and a supply of easily moved raw stock was available.

E. Competing Outlets for Fresh Cabbage

Fresh-market demands are the greatest competing outlets for raw cabbage during times of scarcity. During World War II many lawsuits were instituted because of non-delivery of contracted cabbage to dehydrators. <u>It is apparent, therefore, that strictly enforceable contracts and alert field-men are necessary.</u> Sauerkraut packers compete for cabbage, but since the price they can afford to pay is much less than the unrestricted fresh market price, competition from this source is not serious.

F. Competition With Other Crops for Acreage

Land suitable for growing cabbage is also suitable for growing many other crops such as lettuce, cauliflower, carrots, and sugar beets. The profit from cabbage grown must equal or exceed the profit expected from other possible crops, or growers will not be interested. <u>The price the grower receives is the big persuader in getting him to produce the desired commodity.</u>

G. Considerations in Obtaining Cabbage of Proper Grade

<u>The contract under which the crop of cabbage is grown should emphasize quality.</u> This can be done by specifying the variety and minimum quality standards for maturity; a size-weight standard is usually quite helpful. A list of common defects such as sunburn, frost, insect injury, disease damage, and mechanical damage could be included in

the contract, and provision should be made for specified deductions in the contract price if these defects exceed the agreed tolerance.

It has been pointed out previously that cabbage for dehydration must comply with the requirements for U. S. No. 1 Grade. Table VI illustrates the percentages of various grades of cabbage grown commercially in southern California during 1950 and the first nine months of 1951. The Table indicates the relative amounts of acceptable quality cabbage a prospective dehydrator may expect to obtain from the total crop grown on a typical acreage.

A well qualified and energetic field man can assist growers in producing high quality cabbage by timely advice as to irrigation, fertilizer needs, and insect control.

Much of the lower quality of dehydrated cabbage produced during World War II was due to the cabbage becoming over-mature -- either by intention, by poor scheduling, or by uncontrollable factors such as unfavorable weather conditions.

For a succession of harvestings of cabbage, the planting dates must be made closer together as fall approaches and must be made at longer intervals in spring as the days get longer and temperatures higher. An example of the relationship between seeding dates and days to maturity for Glory of Enkhuizen cabbage grown in the Santa Maria district of California is given in Table VII.

During World War II some California dehydrators paid approximately $16 per ton for one variety (Glory of Enkhuizen) and $18 per ton for another variety (Copenhagen). The average price paid in all districts was probably about $17 per ton. During this same period growers received about $13 per ton for cabbage for sauerkraut. According to Federal Government reports, cabbage sold for fresh market during 1941-1945 gave an average return to the U. S. farmers of about $29 per ton, and to California farmers about $28 per ton. From these figures it would seem that California growers were willing to grow cabbage under contract for dehydrating at a price equal to about 60% of the usual market price of fresh cabbage. Apparently the advantages of higher yields, a sure outlet, and a guaranteed price were valued enough by the growers to influence them to grow cabbage for dehydration at these prices.

Because of the provision in the specifications that allows the requirement for the weight per head to be disregarded in grading raw cabbage for dehydration, some growers can obtain higher yields per acre by harvesting later than is customary for market cabbage. The field man of the dehydrator must, therefore, be diligent in seeing that the cabbage does not become over-mature as it increases in size past the desirable market size. Another factor increasing the apparent yield per acre is that cabbage for dehydration is not usually trimmed so closely in the field as is customary with cabbage for the fresh market. The extra amount of protective leaves helps assure the receipt of better quality cabbage at the plant.

Other Sources of Information

Boswell, V. R. Commercial Cabbage Culture. Rev. ed. Washington, D. C., 1945, (U. S. Dept. of Agriculture Circular 252), 60 p.

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Magruder, R. "Improvement in the Leafy Cruciferous Vegetables". On pages 285-86 of: U. S. Dept. of Agriculture Yearbook, 1937.

Walker, J. C. Diseases of Cabbage and Related Plants. Rev. ed. Washington, D. C. 1948, (U.S. Dept. of Agriculture Farmers' Bulletin 1439), 38p.

TABLE I

Surface and Volume Relationships Between Various Sizes of Cabbage

Diameter of Cabbage Head (inches)	Volume (cu.in.)	Area (sq.in.)
5	65	79
6	113	113
7	180	154
8	268	201
9	382	254
10	524	314
11	697	380
12	905	452

TABLE II
Characteristics of Principal Commercial Varieties of Cabbage

Variety	Typical Growing Time 1/	Principal Use or Disposition	Usual Diameter (Inches)	Head Shape	Reaction to "Yellows"
Domestic Types					
Early Jersey Wakefield	63	Market	5	Very Pointed	Susceptible
Jersey Queen	63	Market	5	Pointed	Resistant
Charleston Wakefield	71	Market	7	Pointed	Susceptible
Early Winnigstadt	80	Market	7	Pointed	Susceptible
Golden Acre	64	Market	6	Round	Susceptible
Resistant Detroit	64	Market	6	Round	Resistant
Copenhagen Market 2/	70	Market	7	Round	Susceptible
Marion Market 2/	75	Market	7	Round	Resistant
Glory of Enkhuizen 2/	80	Market & Kraut	8	Round	Susceptible
Globe 2/	80	Market & Kraut	8	Round	Resistant
Savoy varieties	90	Market	9	Drumhead	Susceptible
All Head Early	80	Kraut	9	Flat	Susceptible
All Head Select	80	Kraut	9	Flat	Resistant
Stains Early Flat Dutch	85	Kraut	10	Flat	Susceptible
Succession	90	Kraut	10	Flat	Susceptible
All Seasons	90	Kraut	11	Flat	Susceptible
Wisconsin All Seasons	90	Kraut	11	Flat	Resistant
Late Flat Dutch	100	Kraut	12	Flat	Susceptible
Resistant Flat Dutch	100	Kraut	12	Flat	Resistant
Danish or Storage types					
Danish Ballhead	100	Storage	8	Round	Susceptible
Wisconsin Ballhead	100	Storage	8	Round	Resistant
Wisconsin Hollander	110	Storage	8	Round	Resistant
Penn State Ballhead	110	Storage	8	Round	Susceptible

1/ Days from setting of plants to maturity
2/ Used for dehydration during World War II

Sources:

Associated Seed Growers, Inc. A Descriptive Catalogue of Vegetables for Canning and Quick Freezing 11th ed. New Haven, Conn., 1942.

Cornell Seed Company. Descriptive Catalogue of Vegetables. 5th ed. St. Louis, 1940.

Ferry-Morse Seed Co. A Descriptive List of Vegetable Varieties. 5th ed. Detroit (1941)

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Magruder, R. "Improvement in the Leafy Cruciferous Vegetables". In (pp.285-86) U.D. Dept. of Agriculture Yearbook, 1937

TABLE III

Cabbage Production, Acreage, Yields, and Prices for Principal Producing States in U. S.

State and Season	Ten-Year Average- 1940 through 1949: Production (Tons)	Acreage (Acres)	Yield Per Acre (Tons)	Price Per Ton ($)	Average Price/Ton: 1950 ($)	1951 ($)	Leading Varieties Grown
New York - Total	300,100	30,340	9.9				
Early Summer - L.I.	10,400	1,090	9.6	33	24	28	Copenhagen Mkt. & Golden Acre
Early Fall-L.I.-Domestic	10,400	1,020	10.3	30	24	50	Wis.All Season & Glory of Enkhuizen
Early Fall-Other-Domestic	117,300	11,130	10.5	22 20 1/	16 20 1/	25 20 1/	Glory of Enkh. & Marion Market
Early Fall-Danish	162,000	17,100	9.5	23	35	45	Danish Ballhead & Wis. Ballhead
Texas - Total	152,300	32,520	4.7	22	12	68	Marion Mkt. & Charleston Wakefield
Wisconsin - Total	124,300	13,670	9.1				
Early Fall - Domestic	91,100	10,030	9.0	18 12 1/	13 10 1/	20 10 1/	Marion Mkt. & Resistant Detroit
Early Fall - Danish	33,200	3,640	9.1	21	14	25	Wis. Ballhead & Wis. Hollander
Florida - Total	118,600	15,260	7.8	40	30	68	2/
California - Total	106,400	12,220	8.8	29	28	59	Copenhagen Mkt. & Glory of Enkh.
Pennsylvania - Total	66,600	8,080	8.2				
Late Summer	42,900	5,340	8.1	34	27	38	2/
Early Fall - Danish	23,700	2,740	8.6	28	18	36	
Colorado - Total	62,100	5,190	12.0				
Late Summer	19,700	1,810	11.0	22 14 1/	14 11 1/	21 12 1/	Globe & Golden Acre
Early Fall - Danish	42,400	3,380	12.4	19	10	32	Wis.Hollander & Ballhead
Michigan - Total	48,300	5,930	8.1				2/
Early Fall - Domestic	35,000	4,310	8.1	43 12 1/	29 10 1/	34 10 1/	
Early Fall - Danish	13,300	1,620	8.2	39	33	35	
North Carolina - Total	46,000	7,890	5.8				2/
Late Spring	8,600	1,660	5.1	42	35	23	
Late Summer	26,000	4,020	6.5	31	20	41	
Late Fall - Danish	11,400	2,210	5.1	35	49	80	
New Jersey - Total	40,700	6,890	6.0				2/
Early Summer	27,600	4,440	6.2	39	31	30	
Early Fall - Domestic	13,100	2,450	5.5	33	23	45	
Ohio - Total	40,900	4,860	8.4				2/
Late Spring	4,700	500	9.4	44	37	32	
Late Summer	29,100	3,420	8.5	41 12 1/	33 10 1/	42 12 1/	
Early Fall - Danish	7,100	940	7.5	41	27	45	
Total of Principal States	1,106,300	142,850	7.7	-	-	-	
Total for Other States	125,300	31,060	4.0	-	-	-	
Total United States	1,231,600	173,910	7.1	29	25	45	

1/ Price for cabbage used for kraut. (Of the summer and early fall production of domestic cabbage, about one-third is used for kraut manufacture. Of the cabbage used for kraut, about one-half is grown on land owned or leased by the processor or grown under contract to the processor).

2/ Variety information not available

Sources:

U.S. Bur. of Agric. Economics. Commercial Truck Crops ... for Commercial Processing, 1951. Washington, D.C., 1951 (Dec. 17)

U.S. Bur. of Agric. Economics. Commercial Truck Crops ... for Fresh Market ... Annual Summary, 1951. Washington, D.C., 1951 (Dec.)

TABLE IV

Production of Cabbage Seed by Varieties 1/

(1948 - 1951)

Variety	1948 (lbs.)	1949 (lbs.)	1950 (lbs.)	1951 2/ (lbs.)
Charleston Wakefield	21,100	83,000	36,200	16,100
Jersey Wakefield	16,400	52,400	88,000	18,100
Early Flat Varieties	46,100	67,300	38,300	20,000
Copenhagen Market 3/ and Golden Acre	95,600	120,800	152,200	43,900
Danish Ballhead Shortstem and Penn State	49,800	31,000	18,400	10,350
Glory of Enkhuizen	66,900	156,100	43,400	14,000
Late Flat Varieties	50,600	47,400	9,200	6,000
Red Varieties	19,000	19,100	11,800	3,600
Savoy Varieties	30,100	10,400	22,500	600
Marion Market 3/	25,800	8,000	8,000	17,200
Other Resistant Varieties	45,600	16,000	5,300	37,600
Other Varieties (regular)	29,100	10,100	34,500	30,400
Total	496,100	621,600	467,800	217,850

1/ Production by 130 commercial growers who usually have accounted for about 95 percent of the total commercial cabbage seed production in the United States.

2/ Indicated by grower intentions

3/ Used to produce cabbage for dehydration in World War II

Source:
U.S. Bur. of Agric. Economics. Acreage and Production of Vegetable Seeds, Jan. 17, 1950, May 15, 1950, Apr. 20, 1951. Washington, D.C., 1950-51

TABLE V

Usual Planting and Harvesting Seasons for Cabbage in Principal Producing States

Season and State	Planting Dates 1/	Harvesting Dates Begins	Most Active	Ends	Growing Districts
All Seasons					
California 2/	May 1 -Apr. 30	Aug. 1	Jan. -June	July 31	Imperial Valley; southern & central coasts
Winter					
Texas	Aug. 25-Jan. 15	Nov. 15	Dec. 15-Apr. 15	May 15	Lower Rio Grande Valley; Corpus Christi & San Antonio
Florida	Sept.15-Jan. 31	Dec. 1	Jan. 1 -Apr. 15	May 10	Hastings, Polk, Marion, & Alachua Counties
Late Spring					
North Carolina	Dec. 1 -Feb. 28	Apr. 15	May	June 15	Eastern & southern
Ohio	Mar. 20-Apr. 5	June 1	June	July 10	Southeastern
Early Summer					
New Jersey	Mar. 25-May 31	June 1	June 10-July 15	Aug. 31	Southern, central, & northern
New York (L.I.)	Apr. 1 -May 31	June 15	June 15-Aug. 31	Aug. 31	Long Island
Late Summer					
Colorado	Apr. 15-Apr. 30	July 15	Aug. -Sept.	Oct. 15	Greeley & Denver; & San Luis Valley
Ohio	Apr. 1 -June 30	July 1	Aug. -Sept.	Oct. 31	Northern
Pennsylvania	Apr. 15-June 15	June 25	July -Sept.	Oct. 15	Waterford; Ringtown & Wyoming Valleys
North Carolina	May 15 -July 15	July 15	Aug. -Oct. 10	Oct. 31	Western counties
Early Fall 3/					
New York (L.I.)	June 1 -July 31	Sept. 1	Sept. -Nov.	Dec. 15	Long Island
New York (Other)	May 15 -July 5	Aug. 1	Sept. -Oct.	Nov. 15	Western & central; Hudson Valley
New Jersey	July 1 -Aug. 10	Sept. 1	Sept. -Oct.	Nov. 15	Northern & central
Michigan	Apr. 1 -June 15	June 15	July -Sept.	Sept. 30	Detroit; southwestern & east central
Wisconsin	May 1 -June 20	July 1	Sept. -Oct.	Oct. 31	Southeastern & eastern
Early Fall 4/					
New York	May 15 -July 15	Sept. 1	Oct. -Nov.	Nov. 30	Western & central
Pennsylvania	June 1 -Aug. 15	Aug. 15	Sept. -Oct.	Nov. 30	Waterford; eastern
Ohio	June 1 -June 30	Sept. 1	Sept. -Oct.	Nov. 10	Northern
Michigan	June 10-July 10	Sept. 15	Oct. -Nov.	Nov. 30	Detroit; south central
Wisconsin	June 10-July 30	Sept. 20	Oct.	Oct. 31	Southeastern & eastern
Colorado	May 1 - May 15	Aug. 15	Sept. -Oct.	Oct. 31	Greeley & Denver; San Luis Valley
Late Fall					
North Carolina	July 15-Aug. 31	Nov. 1	Nov. 10-Dec. 15	Dec. 31	Eastern

1/ Planting dates refer to the period of transplanting or setting to the fields where such is the usual practice.

2/ Imperial Valley district crop planted by direct seeding Sept. 1 to Oct. 15 and harvested Jan. 1 to Apr. 15. In south coast and central coast districts, cabbage is planted for year-round harvest.

3/ Domestic

4/ Danish

Source: U. S. Bur. of Agric. Economics. Commercial Truck Crops for Fresh Market: Usual Planting and Harvesting Dates and Principal Producing Areas by Seasonal Groups and States. Washington, D.C., 1951

TABLE VI

Grades of Cabbage Grown in Southern California
(During 1950-1951)

	1950 (%)	1951 1/ (%)
Graded U.S. No. 1	63	76
Graded 85% - 99% U.S. No. 1	25	23
Graded 50% - 80% U.S. No. 1	6	1
Graded U.S. Commercial	4	0
No grade	2	0
	100	100

1/ For the period January through September, 1951

TABLE VII

Relationship Between Seeding Dates and Days to Maturity for Cabbage in California 1/
(Santa Maria District)

Date Seeded 2/	Number of Days Required to Reach Maturity
April 15	125
May 15	120
June 15	120
July 15	140
Aug. 15	165
Sept. 15	170
Oct. 15	180
Nov. 15	180
Dec. 15	170
Jan. 15	165
Feb. 15	150
Mar. 15	135

1/ Data reported by a California dehydrator for period 1943-1944

2/ Seeded in moist ground or "irrigated up"

HARVESTING CABBAGE

(Courtesy of Ferry-Morse Seed Co.)

CHAPTER III

PLANT PROCEDURES AND FACILITIES

This section gives pertinent information concerning the operating procedures and the facilities required for the cabbage dehydration plant. The information is coded and presented in accordance with the classification key given in Appendix D ("Operation Classification Code") of Volume I. The accompanying flow-sheet, drawings of equipment and facilities, and other illustrative material have been labeled in accordance with this same classification. (Note: This same classification key has been used in compiling the "Cost of Facilities" ~~and~~ "Total Production Costs", and thus affords a useful cross-reference system for identifying or discussing any phase of the operations and/or costs.)

The operational procedures and other facilities needed for this proposed cabbage dehydration plant are presented in accordance with the attached flow-sheet (Figure 2). A floor-plan (Figure 3) is given to show the space and arrangement required for the facilities.

100 — RAW MATERIALS

The problems and methods of procuring a suitable supply of cabbage for a dehydration plant have been discussed in "Supply of Raw Cabbage" elsewhere in these plant plans.

200 — MANUFACTURING OPERATIONS

210 — Raw Material Handling

211 — Weighing (at plant)

It is assumed that the truck-loads of cabbage will be weighed at the plant.

212 — Unloading and storing at the plant
213 — Feeding to line

The raw material should be fed to the processing line preferably within 24 hours after it is harvested. When possible, it is desirable to unload the cabbage from the trucks directly onto the conveyor feeding the preparation line. The advantage in direct unloading stems from the fact that cabbage is hauled in bulk. Intermediate storage involves a costly handling operation. In addition to the extra labor cost, the cabbage is subjected to the possibility of damage from bruising during this handling operation. The proposed plant provides bulk storage area for about 24 hours supply of cabbage, to assure smooth and continuous operation of the plant.

220-230 -- Preparing

A diagrammatic sketch of the "preparation line" for the proposed cabbage plant is given in Figure 4.

224 -- Trimming and coring

The military specification requires that cabbage heads be trimmed (outer wrapper leaves removed) and cored. Inasmuch as the outer leaves are the greenest and contain most of the carotene, it is important that only the leaves that are withered, damaged, or soiled be removed.

The cabbage from the unloading and storage area is carried to the "preparation line" on a conveyor. The heads are then transferred to a merry-go-round belt which transports them to the women doing the trimming and coring.

Two principal methods have been used to core cabbage for dehydration:

(1) The cabbage is pushed against a rotating knife (similar to a reamer) in such a manner that the core is removed. The method is quite simple, and has been used successfully, but has several disadvantages:

   (a) The rotating knife cuts the same amount of core from each head of cabbage, no matter what the size of the cabbage.

   (b) In order to avoid undue waste, the cabbage first must be sized, and then cored with the proper knife for each size.

   (c) The core is not always completely removed because the tool does not enter the cabbage head at exactly the right position and angle each time. If the core is deeper than usual, a greater portion of the cabbage must be cut away to get at the whole core.

   (d) The rotating action of the knife tends to mash the portion of the head surrounding the core, causing damage to the cabbage which is evident in the dried product.

(2) The coring equipment illustrated in Figure 9 is the one most extensively used at present. The cabbage head is placed on a small wooden shelf mounted above, and out of the way of, the material being conveyed on the outer belts. A knife (approximately 18" long, hinged at one end, and counterbalanced so that the knife will remain normally in an upright position) is pulled downward across the board by the operator, thus slicing the cabbage in half. The operator places the halves in a small box between her and the next woman on the line. This next operator cores the cabbage, removes the outer leaves, and perhaps does some other trimming. The coring knife consists of a metal ring or scoop, 2" in diameter, and sharpened on one end. This ring is mounted over the trim table with the sharp end facing the operator and over the chute into which the trimmings fall. The core is removed as the cabbage half is pushed along the ring in such a manner that the sharp end scoops out the core material. The core drops into the chute and is carried away for disposal.

The trimmed and cored cabbage halves are placed on the top side of the center belt where they are conveyed to the next processing step.

This method of coring the cabbage has several advantages:

(a) The core can be removed without also removing an excessive amount of the desirable portions of the cabbage; (b) little, if any, damage is done to the cabbage; and (c) no sizing operation is required as any size head can be effectively cored.

225 — Washing

Cabbage does not require as much washing as other commodities, since the trimming operation removes the dirt along with the outer leaves. Consequently, washing may consist of water-spraying the cored cabbage halves as they are being moved up the elevator to the shredder. The elevator should be designed for handling large units, since some cabbage heads used by the dehydrators may be as much as 14 inches in diameter.

226 — Cutting (shredding)

Military specifications require that cabbage be cut into shreds not less than 1/8-inch nor more than 1/4-inch in width.

Kraut cutters of the type made for sauerkraut manufacturers are used for the shredding operation.

Magnets are provided for removing "tramp" iron from the cabbage before it is shredded in order to avoid damage to the cutting knives.

241.1 — Tray loading

Tray loading is normally classified as a step in the drying operation. Tray loading is discussed here, however, because cabbage must be blanched on trays to avoid the difficult operation of transferring the blanched product from a blancher belt to trays.

Blanching tends to mat down the cabbage shreds and if the material is not already on the trays at this point it is extremely difficult to obtain a layer suitable for the drying operation. To withstand the blanching treatment the trays must have metal bottoms rather than the usual wood slatted bottoms. The wire mesh cloth which comprises the tray bottom is covered with a thin coating of mineral oil just prior to the tray loading operation. This oiling step is considered necessary to prevent excessive sticking of the dried product when it is unloaded.

Cabbage dehydrators generally use a drying tray consisting of a wooden frame and a 1/4-inch mesh galvanized wire-cloth bottom. Some operators have used 18-gauge wire but have found that wire of this gauge sags badly after use. One operator believes that the trays should have 14-gauge wire. The $7.00 cost per tray allowed in Table I (Cost of Cabbage Dehydration Facilities) is based upon a 16-gauge wire galvanized before weaving. A tray built of 14-gauge wire may cost about $8.50. The heavier gauge wire is highly preferable, but the cost may deter operators from making the higher investment.

One World War II cabbage dehydrator used an angle iron frame instead of wood to support the wire cloth. However, since all of the metal must be galvanized to prevent contamination of the product with iron, this type of construction is rather expensive.

In order to achieve uniform drying conditions, it is especially important that the cabbage be loaded evenly on the trays. Lightly loaded areas will dry quickly and might even scorch. Areas loaded too heavily will not dry sufficiently. Tray loading, therefore, is a critical operation which warrants considerable attention.

The efficiency of the tray loading equipment will depend to a great extent on the ingenuity of the design engineer. The unit should deliver a uniformly specified weight of cabbage per square foot of tray area with a minimum of labor to accomplish the final spreading. With shredded cabbage, it has been found that using rotary forks to distribute the discharge from the shredder provided a satisfactory means of tray loading.

In the equipment proposed, the shredder discharges onto a a spreading belt which is six feet wide -- the same width as the trays. The rotary fork extends the width of the spreading belt and is mounted slightly above the belt so that when it is rotated it throws the shreds upward into the air and re-distributes any heavily loaded areas. The spreading belt and the rotary fork should have separate variable speed motor drives to provide the required degree of flexibility.

Some provision should be made for keeping cabbage shreds off of the frames of the trays, since this material will tend to become scorched during the tunnel drying. One simple method of solving this problem is to place V-shaped guards over the edges of each pair of adjoining trays. These guards are placed in position as the empty trays are being fed to the conveyor which moves them beneath the loading set-up. Generally, an operator is stationed on each side of the tray line following the loading station to do the final spreading on the trays. The guards are removed from the trays at this point and sent back to the head of the tray conveying line. Some operators have designed mechanical devices to accomplish the purpose served by the V-shaped guards.

227 -- Blanching and sulfiting

Blanching is usually done with a cabbage loading of one pound per square foot on the trays at a temperature of about 200° F. for 1 1/3 minutes.

The tray conveyor carrying the trays of cabbage shreds through the blancher is equipped with a variable speed drive so that the blanch time may be regulated.

Military specifications require that the cabbage shall be sulfited so that the sulfite content in the dehydrated product is not less than 1500 nor more than 2500 parts per million, expressed as sulfur dioxide. Sulfiting is done in the blancher where the cabbage shreds are sprayed with a solution containing a mixture of sodium sulfite and sodium bisulfite. The sulfite solution usually is applied at a point one-half to two-thirds of the blancher-length from the entrance end of the blancher. By experimenting, the operator can determine the optimum point in the blancher for applying the sulfite so that the penetration into the cabbage will give the desired sulfite content in the dehydrated product. Sulfiting too early in the blanching period results in poor retention, and the product does not contain the minimum required sulfite content. Sulfiting too

near the discharge end of the blancher does not allow sufficient time for drainage, and the trays are still dripping while they are being stacked. This dripping may cause an excessive build-up of sulfite in the material on the trays at the bottom of the stack. Another reason for sulfiting as early as the retention properties of the cabbage allow is that blanching tends to mat down the cabbage shreds into a dense mass. If sulfiting is attempted after blanching is complete, it is difficult to obtain a uniform distribution of the solution on the surfaces of the cabbage shreds.

Corrosion resulting from sulfiting within the blancher has been found to be less of a problem than might be anticipated, provided the composition of the sulfiting solution is maintained at the proper concentration and pH level.

240 — Drying

241 — Tunnel drying

241.1 — Tray loading

(See discussion under Code No. 226).

241.2 — Tray stacking

As the trays move out of the blancher they are automatically stacked onto cars. The type of unit presented in these plans has been used in several existing dehydration plants.

241.3 — Weighing

In order to provide a check on tray loading and also on preparation losses, the loaded car is weighed on scales built underneath a section of the track.

241.4 — Tunnel operating

Cabbage is successfully dried in tray-type driers which circulate air across the trays. Driers which use through-flow of air are not considered satisfactory for cabbage. Blanched cabbage mats down on the supporting surface forming a mass very resistant to the passage of air; the air, therefore, will short-circuit through the free spaces on the tray or belt.

Both single-stage and two-stage tunnel driers have been used in the industry. Cabbage shreds contain a large amount of water (more than most other vegetables that are dehydrated) that may be removed very rapidly in the first stages of drying. Temperatures appreciably higher than are permissible in the final tunnel drying stage may be used for the initial drying process. For this reason, two-stage driers have been selected for this proposed plant.

The design of the tunnels proposed for the cabbage plant is shown in Figures 5 and 6. These tunnels are direct gas-fired and have the combustion chambers overhead. Six two-stage tunnels are arranged in pairs with a single combustion chamber and air blower for each pair. The two stages of the tunnels are designed so that the exhaust air from the secondary stage may be used to make up

the inlet air for the primary stage.

Operating characteristics for the recommended cabbage tunnels include the following:

	Primary Stage	Secondary Stage
1. Direction of air flow	Parallel	Countercurrent
2. Air velocity between trays	1,000 ft./min.	600 ft./min.
3. Volume of air per tunnel	25,000 c.f.m.	15,000 c.f.m.
4. Type of firing	Direct	Direct
5. Type of fuel	Gas	Gas
6. Inlet air temperature	180° F.	145° F.
7. Tray loading	1.0 lb./ sq.ft.	—
8. Size of trays	3 ft. x 6 ft.	3 ft. x 6 ft.
9. Number of trays per car	25	25
10. Cars per tunnel	6	12
11. Moisture in product entering	93%	75%
12. Moisture in product leaving	75%	7%
13. Drying time 1/	2 hours	4 hours

241.5 — Tray unloading and stacking

Upon completion of the drying operation in the secondary tunnels, each loaded car is moved to the tray unloading station.

The product may be removed from the drying trays either manually, semi-automatically, or completely automatically. The semi-automatic method, in which the trays are manually removed from the cars and turned over a revolving wire brush, has been selected for the proposed cabbage plant. This type of operation usually results in a longer tray life than does the manual type of tray scraping.

After the product has been removed from the trays, the trays are restacked on a car. The car of empty trays is moved to the tray loading station where the trays are oiled prior to starting a new cycle.

241.6 — Elevating and conveying

The dried product scraped from the trays is elevated and transported on an overhead conveyor to the bin drying room.

1/ The drying times cited are near the maximum that should be experienced in plant operation.

241.7 — Tray washing

The trays are washed on the conveyor between the blancher and tray loading station. It is assumed that the trays are washed once a week during a clean-up period on Sundays when the plant is shut down.

248 — Bin drying

248.1 — Bin loading
248.2 — Bin operating
248.3 — Bin unloading

This set of plans provides for doing the final drying in bins, where the moisture content of the product is reduced from approximately 7% down to the 4% maximum stipulated in the military specifications.

Opinions among major World War II producers of dehydrated cabbage are divided regarding the desirability of the use of bins in finishing-drying of cabbage. The advantages of bin drying are discussed in Volume I, Chapter X.

Opponents of bin drying for cabbage claim that:

(a) At the higher moisture content at which cabbage is removed from the drying trays, sticking is serious.

(b) If the cabbage is dry enough to remove easily from the trays, it is brittle and subject to shattering. The extra handling results in excessive production of "fines".

In spite of these objections, bin finishing has been used successfully by at least one large cabbage dehydrator. The proposed cabbage plant uses portable bins and a bin room designed on the basis of the following data:

1) Air flow rate through bins	- 100 c.f.m. per sq. ft. of cross-section
2) Inlet air temperature to bins	- 120° F.
3) Drying time	- 7 hours maximum
4) Bulk density of dried cabbage shreds (Approx. 7% moisture content)	- 9 lbs. per cu. ft.
5) Depth of material in bins	- 4 feet

The design of the portable bins is shown in Figure 7. The dimensions of the bins for the cabbage plant are 3 ft. wide by 5 ft. long by 5 ft. high. Twelve bins are provided in these plans Seven bins can be placed simultaneously on the drying line; the additional five bins provided will be used for loading, unloading, and for holding dried cabbage if necessary.

250 — Inspecting

251 — Elevating
255 — Inspecting

The dried product is dumped from the portable drying bins onto the final inspection belt. Military specifications permit a maximum of 15% of the weight of the material to pass through a U. S. Standard 8-mesh sieve. Consequently, it has not been found necessary to propose a screening operation to meet the specification requirements, provided reasonable care is taken to minimize the production of "fines". (None of the commercial dehydrators use a screening operation for removal of "fines".)

Military specifications require that the finished product shall contain not more than 2% by weight of defective pieces. Defective units are considered to be those damaged by insect, pathological injury, decay, scorch, bruise, tray blackening, dirt, peel, tough fibrous core, discoloration, or other abnormality.

Foreign particles such as tray splinters, pieces of metal, etc. must be removed.

In the handling of dried cabbage, where no screening operation is necessary, it is convenient to use a hoist to dump the contents of the bin directly onto the inspection belt. A chute or hopper may be constructed to distribute the shreds across the full width of the belt. The operator for the electric hoist can help to provide some manual distribution of the product as it is dumped.

260 — Packaging and Packing

261 — Filling, packing, and sealing

Equipment to do the filling and weighing varies from plant to plant in the dehydration industry. The rate of handling the cans is low, so that expensive or complicated equipment is not justified. Manual operations are permissible to a greater extent in packaging cabbage shreds than in most can-filling lines. At least two general packaging methods may be considered:

(1) The approximate weight is pressed into the can, the can is transferred to a scale, and the quantity of cabbage in the can is adjusted to the required weight. The pressing operation can be done mechanically or manually. When the pressing is done mechanically, the can is positioned under a cylindrical chamber through which a hydraulically-operated piston travels. The chamber and the can are filled with approximately the required weight of dehydrated cabbage; the piston then presses the shreds into the can, leaving some space in the top of the can for final adjustment of weight.

(2) An extension collar is placed in the can, the exact weight put into the can and collar while on a scale, and the cabbage is pressed into the can by a hydraulic plunger. The collar then can be removed, and the can is ready for sealing.

It is suggested that the proposed plant use the second method. The first step in this operation is to heat the dehydrated cabbage under

a bank of lamps to make it more pliable. Approximately a 2-to-1 compression is required (i.e., reduce the space occupied by the dehydrated shreds to one-half its normal volume) to get 1 3/4 pounds (as required by military specifications) into a #10 can. Compression is done with a vertical plunger actuated by a hydraulic cylinder.

After the required weight of product has been compressed into the can, a recipe sheet containing cooking directions is inserted. Before the can is sealed, the air in the interior must be replaced with nitrogen or carbon dioxide. Storage tests on dried cabbage indicate that oxygen greatly speeds up the rate at which the material loses its vitamin content, palatability, and color. Consequently, military specifications require that every effort should be made to reduce the oxygen content to less than one percent in the container. Inert gas is introduced into the cans as described in Chapter X of Volume I.

Specifications require that the outside of each can bear information about the contents, the processing date, and the manufacturer. The date can be stamped or stencilled on the can at the time of sealing. The remainder of the labelling is generally lithographed on the can by the can manufacturer.

<u>262</u> — <u>Case forming, filling, sealing, marking</u>

Military specifications permit the use of either wood boxes or fiberboard cartons of definite types; the military bids and contracts will specify the exact types of packing to be supplied by the dehydrator. Present-day dehydrators use either mechanical or manual casing operations.

<u>270</u> — <u>Warehousing and Shipping</u>

The cases are stacked on pallets which in turn are transported by a lift truck into storage or to the shipping platform. It is presumed that the pallets will not be shipped, and that the goods will be unloaded from the pallets in the shipping cars.

GENERAL FACILITIES

The requirements for other needed facilities have been discussed in Volume I, and the information will not be repeated here. The principal "general" facilities for the cabbage plant are listed in the "Cost of Facilities" for this proposed plant; included are items for utilities, maintenance and repairs, inspection and control, miscellaneous plant facilities, automotive, and administrative facilities and supplies.

<u>325</u> -- <u>Waste disposal</u>

The waste material from the preparation line will be conveyed into an overhead hopper. This hopper should be located so as to permit trucks to back under the discharge chute to remove the trimmings. These solid wastes would most likely be used for stock feed, but they may have to be trucked to the dumps.

Disposal of waste water from a cabbage dehydration plant should not be a serious problem, because the water usage is relatively small and there is no peeling operation to add solids to the water. The liquid

waste might be run into sewers, streams, irrigation ditches, seepage ponds, lagoons, or waste land, depending upon what is available and upon local and state regulations.

BUILDINGS AND GROUNDS

Buildings and grounds for a cabbage dehydration plant should conform with the general requirements described in Volume I under "Plant Location" and "Selection of Plant Procedures and Facilities". A minimum of three acres of land should be provided for the cabbage plant depicted herein; more acreage would be advisable in many cases.

Figure 3 shows a suggested plant layout. The various processing functions are located to permit ready expansion if such a step is necessary. The raw commodity storage area would expand away from the plant proper, as indicated on the drawing. The coring and trimming line could expand into the presently-indicated raw material storage area. Bin drying, inspection, and packaging operations could expand either into the finished product storage space or outside the original building. Finished product storage area could expand in two directions as indicated on the drawing. The tunnel drying facilities would expand outside the building, the original design being such as to permit almost any number of tunnels to be added. Space for additional storage of cars and trays could be provided in an extension of the building.

If it becomes desirable to expand the production facilities, the present blancher could be lengthened considerably or another blancher could be installed. A longer blancher could be put in the line by having the trimming belt (Code 224) moved closer to the laboratory, thus moving the shredding and tray loading operation in that direction to allow more space for the longer blancher. On the other hand, a second blancher might be put parallel to the first one with some rearrangement of the lines to obtain the necessary space.

The boiler room is shown attached to the main building to permit a reasonably short length of steam pipes to the blancher. If the boiler is located at some distance from the plant, a saving in fire insurance rates might be possible, but steam transmission losses would be higher.

The locations of the offices, laboratory, rest rooms, and lunch room are only suggestive. These could be rearranged without seriously affecting plant operation.

Floor drains should be provided in the preparation area, particularly under the blancher (Code 227), washer (Code 225), trimming table (Code 224) and along the tray stacking and weighing line, and under each of the transfer tracks.

CHAPTER IV

COST OF CABBAGE DEHYDRATION FACILITIES

Cost Summary

200 -- MANUFACTURING OPERATIONS FACILITIES		
210 -- "Raw Material Handling" Equipment	$ 12,645	
220-230 -- "Preparing" Equipment	22,975	
240 -- "Drying" Equipment	131,250	
250 -- "Screening & Inspecting" Equipment	2,460	
260 -- "Packaging & Packing" Equipment	22,750	
270 -- "Warehousing & Shipping" Equipment	5,200	
Total for MANUFACTURING FACILITIES		$197,280
GENERAL FACILITIES		
320 -- "Utilities" Equipment	$ 19,890	
330 -- "Maintenance & Repairs" Equipment & Supplies	15,000	
380 -- "Inspection & Control" Equipment	5,000	
390 -- "Miscellaneous Plant" Equipment	4,700	
400 -- "Automotive" Equipment	3,500	
690 -- "Office & First Aid" Equipment & Supplies . .	4,500	
Total for GENERAL FACILITIES		$ 52,590
Total for Plant Equipment (TABLE I)		249,870
Total for Buildings & Grounds (TABLE II)		155,000
Construction Engineering Fees		30,000
TOTAL COST FOR ITEMIZED PHYSICAL FACILITIES FOR CABBAGE DEHYDRATION PLANT		$434,870

Critical Materials in the Equipment for a 100-ton per Day Cabbage Dehydration Plant

Material	Estimated Total No. of Pounds in Equipment	Percentage of Total Weight of Critical Materials
Iron and Steel	233,000	92.24
Copper	1,800	0.71
Zinc	17,200	6.81
Tin	100	0.04
Rubber	500	0.20
	252,600	100.00

Disclaimer Statement

The designation of any manufacturer or brand-name equipment does not imply a specific recommendation by the Department of Agriculture. Such inclusion means only that these particular items have been found satisfactory for the purpose indicated; other sources and items may prove equally satisfactory. Additional information concerning suggested manufacturers of equipment may be found in "Additional Sources of Information" (Volume I, Appendix C).

TABLE I — PLANT EQUIPMENT FOR A 100-TON PER DAY CABBAGE DEHYDRATION PLANT

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
		200 -- MANUFACTURING OPERATIONS FACILITIES				
210 -- Raw Material Handling						
211 -- Weighing (at plant)						
a.	Truck scales: To weigh incoming loads of raw commodity (not required for plants having access to public scales)	Fairbanks Morse Code 6512 (13,700 lbs)	Platform 10' x 60', capacity 50 tons; equipped with type registering beam; includes structural steel for timber deck. Cost includes $350 installation charge, and does not include pit	1	$ 3,750	$ 3,750
b.	Pit & housing for scales	--	Estimated cost for constructing pit and housing for scales	-	--	3,000
213 -- Feeding to line						
b.	Conveyor: To move cabbage from bulk storage or from trucks to preparation table	FMC 1/ Figure 5030 (1,800 lbs)	24" wide x 45' center-to-center rubber belt feed conveyor, steel frame construction; complete with 1 1/2 h.p. motor	1	2,705	2,705
c.	Portable conveyors: To move cabbage from bulk storage bins to conveyor (213-b) feeding preparation line	Rapid-Standards Co. Press-Veyor Model PVB-18-3/4 (700 lbs each)	Portable type conveyor with 18" canvas cleated belt; 6' lift in 18' horizontal run; adjustable angle; complete with 3/4 h.p. motor	2	650	1,300
			Sub-total			$ 10,755
Allowance for Freight Charges (factory-made equipment)			-- 17,000 lbs. at 5¢/lb.			850
Allowance for Installation of Conveyors -- 25% of equipment cost plus freight ($4,165) 2/			. . . .			1,040
	Total Cost of "Raw Material Handling" Equipment					$ 12,645
220-230 -- Preparing						
224 -- Trimming, halving, coring						
b.	Halving, coring, & trimming tables: To supply cabbage heads for halving, coring, and trimming and to remove trimmed cabbage and cuttings	FMC Figure 9329 (4,500 lbs)	Merry-go-round trim table consisting of 3 parallel 18" wide x 30' center-to-center rubber belt conveyors, outer belts for untrimmed cabbage heads, return side of outer belts for cuttings; inner belt to be raised so that return side acts as merry-go-round return for overflow from outer belts; top side middle belt for conveying trimmed product to discharge point; steel frame construction; complete with 3 h.p. motor	1	$ 6,255	$ 6,255
c.	Halving and coring equipment: To cut the cabbage heads in halves and to remove the cores from the cabbage halves	Custom built	Halving knife approximately 18" long hinged at one end and provided with counterweight to elevate blade after cutting; cylindrical corer 2" diameter mounted with sharp edge facing operator; wood shelf for holding cabbage head during halving (See Fig. 9)	8	25	200
225 -- Washing						
a.	Elevator-washer: To elevate the trimmed cabbage to the shredder and also to provide for a light spray washing	FMC Figure 5071 (1,000 lbs)	24" wide x 7' discharge height, standard cannery elevator for cabbage; steel slats and flights and with approximately 12" flight spacing; steel frame construction; side chains driven by 1 h.p. motor	1	2,535	2,535
226 -- Cutting						
b.	Shredder: To cut the cabbage into shreds of the desired width	FMC Figure 585 (650 lbs)	Buffalo Kraut Cutter, #9 German pattern; 16 interchangeable knives with variable setting for sidth of cut; complete with 2 h.p. motor	1	1,175	1,175
227 -- Blanching and sulfiting						
b. & c.	Blancher-sulfiter: To provide for the blanching and sulfiting of the trayed cabbage shreds	FMC Figure 9330 (10,000 lbs)	6' wide by 40' covered length steam blancher, steel frame construction, with two drag chains for conveying trays; includes 15' drag chain conveyor ahead of covered section for moving trays under tray loader; complete with 3 h.p. variable speed motor drive	1	7,000	7,000

1/ Food Machinery & Chemical Corp.
2/ Equipment cost based on F.O.B. manufacturer's price plus allowance for freight charges at 5¢/lb.

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
c.	Sulfite tanks: To provide for make-up and delivery of sodium sulfite solution to circulating pump	(500 lbs each)	500 gallon fir-wood tank, 4' high	2	$ 100	$ 200
c.	Sulfite pump: To deliver sulfite solution from storage to spray nozzles in sulfiting section of blancher	Tri-Clover Model 1 CR (100 lbs)	Centrifugal type sanitary pump; 1 1/4" x 1"; bronze; complete with 1/2 h.p. motor	1	$ 110	110
			Sub-total			$ 17,475
Allowance for Freight Charges (factory-made equipment) -- 18,000 lbs. at 5¢/lb.						900
Allowance for Installation Charges -- 25% of equipment cost (plus freight cost) ($18,375)						4,600
	Total Cost of "Preparing" Equipment					$ 22,975
240 -- Drying						
241 -- Tunnel drying						
241.1 -- Tray loading						
a. & b.	Tray loader: To distribute the discharge from the shredder and to adjust the rate of flow of the cabbage shreds so that the desired tray loading is obtained	FMC Figure 8681 (3,000 lbs)	6' wide x 10' center-to-center galvanized flat wire spreading belt with 1 h.p. variable drive; rotary spreading fork mounted over belt, driven by 1/2 h.p. variable speed motor	1	3,300	3,300
241.2 -- Tray stacking						
a.	Tray stacker: To stack loaded trays on cars	Knipschild Dehydrator Co. (4,000 lbs)	Loaded trays are lifted vertically from tray conveyor and moved horizontally until positioned over empty car, then stacked to a height of 25 trays; fully automatic	1	3,600	3,600
241.3 -- Weighing						
a.	Scales: To weigh loaded cars of cabbage	Toledo Model 31 - 1921 FE 76 x 54 FF (2,000 lbs)	Dial type indicating system; 2,600 lbs. capacity. Installed in pit with platform level with floor; 76" x 54" platform. Extension lever permits location of dial column out of path of cars	1	980	980
241.4 -- Tunnel operating						
a.	Trays: To hold the shredded cabbage during blanching, sulfiting, and tunnel drying operations	Custom built	6' x 3' wood frame with bottom of 1/4" galvanized wire cloth (see text regarding wire gauge)	4,500	7	31,500
b.	Tunnel driers: To dry shredded cabbage to 6-8% moisture	Custom built (See Figures 5 and 6)	Two stages with parallel flow in primary and counter-current flow in secondary; 6 cars in primary, 12 cars in secondary; with necessary control equipment, trackage, cars, etc.	3	--	80,000
241.5 -- Tray unloading & stacking						
a.	Tray scraper: To remove dried cabbage from trays	Knipschild Dehydrator Co. (1,500 lbs)	Trays are manually removed from cars and turned over a revolving wire brush which loosens the cabbage; cabbage falls into hopper	1	1,400	1,400
241.6 -- Elevating and conveying						
a.	Elevator: To lift dried cabbage from tray scraper to conveyor feeding drying bins	FMC Figure 542 (1,800 lbs)	Gooseneck elevator conveyor with galvanized iron buckets, 16" wide; 14' discharge height; complete with 1 h.p. motor	1	900	900
b.	Conveyor: To move dried cabbage from elevator to loading station for the portable drying bins	FMC Figure 5030A (1,500 lbs)	18" x 20' rubber belt conveyor, steel frame construction, complete with 1 1/2 h.p. motor	1	1,510	1,510
			Sub-total			$ 123,190
Allowance for Freight Charges (factory-made equipment) -- 14,000 lbs. at 5¢/lb.						700
Allowance for Installation Charges -- 25% of equipment cost plus freight ($12,390)						3,100
	Total Cost of "Tunnel Drying" Equipment					$ 126,990

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

CodeNumber & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
248 -- Bin drying						
248.1	-- Bin loading					
a.	Portable bins: To hold the cabbage shreds during the final drying operation	Custom built (See Fig. 7)	3' wide x 5' long x 5' high, sheet metal or plywood construction; mounted on casters and equipped with ring for dumping by means of hoist; expanded metal screen to serve as false bottom; 10" diameter air inlet duct	12	$ 65	$ 780
248.2	-- Bin operating					
b.	Blower: To circulate air through the bank of heating coils and through the drying bins	Sturtevant Silentvane No. 80, Design 10, Class II (900 lbs)	Single width; bottom horizontal discharge; 10,000 c.f.m. at 5" s.p.; 15 h.p. motor and drive	1	1,000	1,000
c.	Heating coils: To heat the air going to the drying bins	Aerofin Corp. Type F Non-Freeze Coil, Series 80 (400 lbs)	Bank of coils, 3 rows deep, 24 tube face, 4' tubes	1	600	600
d.	Ductwork: To take air from outside the building, conduct it through the fan and heating coils, and to each of the 7 drying bins	Custom built	Horizontal run laid on floor, 30' length, 10 sq. ft. cross section; 7 outlets on one vertical face, spaced 3'6" center-to-center, and tapered to 10" diameter collars; vertical run (15' rise) from fan up to extend through roof of building; including enclosure of fan and heating coils	1	1,000	1,000
248.3	-- Bin unloading					
a.	Hoist: To elevate the drying bins for dumping of the dried product	Yale Midget King Electric Hoist Model No. 1/2 E 17 H (100 lbs)	Hook type, 1,000 lbs. capacity; 10 ft. lift; 17 f.p.m.; 1/2 h.p.	1	315	315
			Sub-total			$ 3,695
Allowance for Freight Charges (factory-made equipment) -- 1,400 lbs. at 5¢/lb.			. . . .			70
Allowance for Installation Charges -- 25% of equipment cost plus freight ($1,985)			. . . .			495
Total Cost for "Bin Drying" Equipment			. . . .			$ 4,260
Total Cost for "Tunnel Drying" Equipment			. . . .			126,990
Total Cost for "Drying" Equipment			. . . .			$131,250
250 -- Inspecting						
255 -- Inspecting						
b.	Inspection belt: To convey the product past the final inspection station	FMC Figure 5031 (1,500 lbs)	30" wide x 16' center-to-center white rubber belt; steel frame construction; 1 h.p. motor	1	1,300	1,300
d.	Magnet: To remove any particles of iron and steel from dried product	FMC Cesco Plate Magnet (20 lbs)	Steel face plate, 12" wide; standard model	1	90	90
			Sub-total			$ 1,890
Allowance for Freight Charges (factory-made equipment) - 1,600 lbs. at 5¢/lb.			. . . .			80
Allowance for Installation Charges - 25% of equipment cost plus freight ($1,970)			. . . .			490
Total Cost of "Inspecting" Equipment			. . . .			$ 2,460
260 -- Packaging and Packing						
261 -- Filling, packing, and sealing						
a.	Elevator: To lift the product from the inspection belt discharge to the heating belt	FMC Figure 542 (1,360 lbs)	Gooseneck elevator-conveyor with galvanized iron buckets, 16" wide; 10' discharge height; complete with 1 h.p. motor	1	$ 810	$ 810
a.	Conveyor: To move the product under the bank of heating lamps	FMC Figure 5032 (1,200 lbs)	36" wide x 12' long center-to-center rubber belt; steel frame construction; complete with 1 h.p. motor	1	1,580	1,580

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
b.	Heating unit: To warm the product prior to compression	Custom built	Bank of 36 infra-red lamps, 350 watts each, mounted in insulated hood over conveyor belt	1	$ 200	$ 200
c.	Filling & weighing machine To deliver the required weight of product into #10 can	Exact Weight Model 4103-FM-1-30 (500 lbs)	Vibra-flow feeder; electronic amplifier unit for two rates of flow; with Shadowgraph scale; 4 lb. capacity	1	840	840
d.	Pressing unit: To compress product sufficiently to get required weight into can	Custom built	Air-operated ram with 10" stroke; open height to accommodate 7" can plus 8" collar	1	400	400
e.	Air compressor: To supply compressed air for operation of press	Curtis Model V-906 (525 lbs)	Two-stage; 7.13 cu. ft. air displacement; complete with horizontal ASME tank, and 1 1/2 h.p. motor	1	400	400
f.	Vacuumizing and gassing unit: To replace air in cans of product with inert gas	American Can Co. #3 (1,080 lbs each)	Consists of vacuum chamber holding 10 #10 cans, trays, gas expansion tank, filter, vacuum regulator, 3-way valve, and stand	3	955	2,865
f.	Vacuum pumps: To draw vacuum of 29.5" in vacuumizing and gassing units	Beach-Russ 100-D (1,500 lbs each)	Rotary piston type; rated capacity 115 c.f.m.; water cooled; dry vacuum type	2	1,340	2,680
f.	Gas piping assembly: To reduce pressure of gas from gas cylinders, provide gas storage at intermediate pressure, and convey gas to vacuumizing and gassing units	Custom built	High pressure manifold for 6 gas cylinders; 2 pressure reducing valves; 1 intermediate pressure storage tank; and required pipe lines	1	300	300
g.	Closing machine (seamer): To seal the covers on the cans	American Can Co. No. 1 (1,050 lbs)	Semi-automatic machine operated by depressing foot treadle for each clinching operation; complete with 1 1/2 h.p. motor	1	850	850
h.	Can conveyor: To move cans from feeding station to filling and weighing machine, and to closing machine	FMC (650 lbs)	6" wide x 15' center-to-center impregnated fabric belt supported on zig-zag half-round bars; including can stops, discharge table, feed shelf; complete with 1/2 h.p. motor	1	860	860
262 -- Case forming, filling, sealing, and marking						
a.	Case branding machine: To print required marking on cases	Elliott Manufacturing Co. (2,225 lbs)	Automatic machine equipped to handle box shook and flat fibre cases; complete with 1 h.p. motor and variable speed drive	1	1,980	1,980
b.	Case sealing machine: To seal top and bottom flaps on cases	Elliott Model A (4,000 lbs)	Fully automatic sealer with 16' compression section; complete with 3/4 h.p. motor on gluing section and 3/4 h.p. motor on compression section	1	3,535	3,535
			Sub-total			$ 17,300
Allowance for Freight Charges (factory-made equipment) - 18,000 lbs. at 5¢/lb.						900
Allowance for Installation Charges - 25% of equipment cost plus freight ($18,200)						4,550
	Total Cost of "Packaging & Packing" Equipment					$ 22,750
270 -- Warehousing and Shipping						
271 -- Palletizing						
a.	Pallets: For handling empty and filled cans and cases	--	Wood; 48" x 60"; double faced	500	4	2,000
272 -- Warehousing						
a.	Lift truck: To move palletized loads within warehouse	Yale Model KG 51-T-20L (4,300 lbs)	Capacity 1 ton; gasoline engine	1	2,950	2,950
			Sub-total			$ 4,950
Allowance for Freight Charges (factory-made equipment) - 5,000 lbs. at 5¢/lb.						250
Allowance for Installation Charges						None
	Total Cost of "Warehousing and Shipping" Equipment					$ 5,200
	TOTAL COST OF MANUFACTURING OPERATIONS FACILITIES					$197,280

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
			GENERAL FACILITIES			
<u>320</u> -- <u>Utilities</u>						
<u>321</u> -- <u>Water supply</u>						
a.	<u>Water pump</u>: To elevate water from well and to deliver it throughout plant at required pressure	FMC (Peerless) Deepwell Turbine Type Pump (3,200 lbs)	100 g.p.m. at 80 p.s.i.; complete with 10 h.p. motor	1	$ 1,620	$ 1,620
c.	<u>Water well</u>: For supplying water sufficient to meet needs of the plant	--	Cost includes digging and casing of well and small housing for pump motor	1	2,000	2,000
<u>324</u> -- <u>Steam supply</u>						
a.	<u>Steam boiler</u>: To supply steam for blanching, bin drying, tray washing, wash rooms, heating, etc.	Cleaver-Brooks Model LR 400-15 (21,200 lbs)	Complete package unit: four-pass horizontal fire-tube boiler with integral channel iron frame and burner assembly; 150 boiler horsepower rating, 125 p.s.i. design pressure; equipped for burning #6 oil and gas; includes 7 1/2 h.p. blower motor, 1/3 h.p. spinner motor, and 1/3 h.p. oil supply motor	1	8,400	8,400
<u>325</u> -- <u>Waste disposal</u>						
a.	<u>Sewage screen</u>: To separate solids from water in sewage disposal system	FMC Figure 1436 North Sewage Screen (2,200 lbs)	Trunnion type; 4' screen length; #20-mesh bronze wire; 100 g.p.m. capacity; complete with tank and 1/4 h.p. motor	1	1,700	1,700
b.	<u>Conveyor</u>: To move trimmings from preparation table and solids from sewage screen to elevated waste hopper	Link-Belt cull conveyor with custom built framework and trough (265 lbs)	Wood framework and ~~1/4~~ 14" trough; maple flights 1-5/8" x 3-5/8" x 13" mounted on F2 attachments on every eighth link of #477 chain; 20' rise in 30' horizontal run; 3 h.p. motor included	1	600	600
c.	<u>Waste hopper</u>: To hold solid waste until trucked away	Custom built	15' x 15' x 10' height with sloping sides and discharge gate; elevated for clearance of 10'	1	800	800
			Sub-total			$ 15,120
<u>Allowance for Freight Charges</u> (Factory-made equipment) - 27,000 lbs. at 5¢/lb.						1,350
<u>Allowance for Installation Charges</u> - 25% of equipment cost plus freight ($13,670)						3,420
	<u>Total Cost of "Utilities" Equipment</u>					$ 19,890
<u>330</u> -- <u>Maintenance and Repairs</u> 3/						
a.	<u>Maintenance shop equipment</u>: To maintain plant in proper operating condition; to make necessary repairs	--	Includes welding and cutting equipment; drill presses; cut-off saws; sheet metal cutting facilities; hand tools for carpentry, electrical, and metal work; pipe threading and cutting equipment; miscellaneous supplies	-	--	5,000
b.	<u>Maintenance parts & supplies</u>: Standing inventory of spare parts and maintenance supplies to assure continuous operation of the plant	--	Pipe, sheet metal, fittings, electric motors, equipment parts, welding supplies, etc.	-	--	10,000
	<u>Total Cost of "Maintenance & Repairs" Equipment and Supplies</u>					$ 15,000
<u>380</u> -- <u>Inspection and Control</u> 3/						
<u>381</u> -- <u>Laboratory testing</u>						
a.	<u>Laboratory equipment & supplies</u>: To do necessary control testing of processing operations and of finished products	--	Apparatus, supplies, tables, hoods, benches, and other facilities needed for tests and control purpose	-	--	5,000
	<u>Total Cost of "Inspection and Control" Equipment and Supplies</u>					$ 5,000

3/ Costs indicated for these items include installation costs

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
390 -- Miscellaneous Plant Equipment 3/						
a.	Lunch room: To accomodate up to 50 people at a time	--	--	-	--	$ 3,500
b.	Fire-fighting equipment: For emergency use	--	2 - 300-ft. hoses & reels; 2 emergency showers; 8 - 5-gal. extinguisher tanks; 12 hand extinguishers; 12 gas masks	-	--	1,200
	Total Cost of "Miscellaneous Plant" Equipment					$ 4,700
400 -- Automotive Equipment						
a.	Truck: For miscellaneous work to keep plant in proper operation	GMC	1-1/2 ton pick-up truck (delivered price)	1	$ 3,500	3,500
	Total Cost of "Automotive" Equipment					$ 3,500
690 -- Miscellaneous Administrative Supplies and Facilities 3/						
a.	Office furniture, supplies, and first-aid facilities: For bookkeeping, payrolls, business transactions; personnel work; first-aid	--	--	-	--	4,500
	Total Cost of "Miscellaneous Administrative Supplies & Facilities"					$ 4,500
	TOTAL COST OF "GENERAL" FACILITIES					$ 52,590

TABLE II

BUILDINGS AND GROUNDS FOR A CABBAGE DEHYDRATION PLANT

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
	Building & Grounds: Suitable building and grounds for the cabbage dehydration plant	--	Includes: land; and a building complete with industrial lights, utility and sewer lines within the building, toilet facilities, and loading ramps (or platform)			
			Building - 30,000 sq. ft. at $5/sq. ft.			$150,000
			Raw material bulk storage (estimated)			5,000
	TOTAL COST OF BUILDING AND GROUNDS					$155,000

TABLE III

OPTIONAL EQUIPMENT FOR A CABBAGE DEHYDRATION PLANT

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
321 -- Water supply						
a.	Diesel engine: For standby use for operating the well water pump	Fairbanks-Morse Co.	Diesel engine complete with fuel tank and connecting gears for attaching to well water pump. Cost for this standby service is in addition to the cost of pump equipment listed	1	$ 1,000	$ 1,000
322 -- Fuel supply						
a.	Butane storage tank: To supply standby fuel sufficient for 3 to 4 days of plant operation in case of emergency shutdown of regular gas supply (tunnels, boiler, etc.); also to use in conjunction with "interruptible" type public gas service	--	26,600 gal. horizontal steel tank (Standard design) supplied by butane gas distributors: complete with vaporizor, pumps, controls, connecting piping to building, and supporting structure	1	20,000	20,000
394 -- Miscellaneous						
a.	Hand trucks, auxiliary tables and other similar equipment	--	--	-	--	5,000
Allowance for Freight Charges (None)						None
	TOTAL COST FOR "OPTIONAL" FACILITIES					$ 26,000

Chapter V

PRODUCTION COSTS
FOR A 100-TON PER DAY CABBAGE DEHYDRATION PLANT

Table I -- Summary of Cost of Producing Dehydrated Cabbage
(Assuming Different Raw Material Costs and Shrinkage Ratios)

Overall-shrinkage ratio of:		17 to 1	20 to 1	25 to 1
Output of finished product per day (lbs.)		11,765	10,000	8,000
		Production Cost per Pound of Product		
Processing Cost - See Table II		$0.3752	$0.4141	$0.4784
Assumed cost per 100 tons of Raw Material Entering Processing Line				
At $10 a ton	$1,000 a day	$0.0850	$0.1000	$0.1250
15	1,500	0.1275	0.1500	0.1875
20	2,000	0.1700	0.2000	0.2500
25	2,500	0.2125	0.2500	0.3125
30	3,000	0.2550	0.3000	0.3750
40	4,000	0.3400	0.4000	0.5000
Assumed Production Cost 1/ at Various Costs of Raw Material				
At $10 a ton		$0.4602	$0.5141	$0.6034
15		0.5027	0.5641	0.6659
20		0.5452	0.6141	0.7284
25		0.5877	0.6641	0.7909
30		0.6302	0.7141	0.8534
40		0.7152	0.8141	0.9784
Estimated Depreciation Charge (See Table X)				
Normal Life Expectancy		$0.0066	$0.0078	$0.0097
Accelerated Write-off		0.0222	0.0261	0.0326

1/ Exclusive of Depreciation Charges

Table II -- Processing Cost Summary Using 3 Different Overall Shrinkage Ratios
(Depreciation not included)
(Cabbage Dehydration Plant)

	17 to 1 (Low)	20 to 1 (Average)	25 to 1 (High)
Input - lbs. per day raw commodity	200,000	200,000	200,000
Output - lbs. per day net yield of cabbage shreds	11,765	10,000	8,000
Total daily processing cost based upon cost calculation using a 20 to 1 overall shrinkage ratio	$4,141	$4,141	$4,141
Adjustment for labor -			
Add 17% of cost of inspecting, packaging, warehousing, and shipping ($630)	+ 107		
Deduct 20% of cost of inspecting, packaging, warehousing, and shipping ($630)			- 126
Adjustment for packaging supplies -			
Deduct total packaging supply cost based on a 20 to 1 ratio (see Table III)	- 940		- 940
Add cost applicable to shrinkage ratio (pounds x $0.094)	+ 1,106		+ 752
Adjusted cost 1/	$4,414	$4,141	$3,827
Cost per pound of net product	$0.3752	$0.4141	$0.4784

1/ For purposes of this illustration, it is assumed that all costs per day would be constant for the various yields except the two cost items adjusted. In actual practice, however, costs would be more variable as a result of the different shrinkage ratios

Table II-A -- Calculation of Unit Costs of Processing for Various Shrinkage Ratios
(Assuming constancy of cost except as calculated in Table II)

	17 to 1		20 to 1		25 to 1	
	Daily Cost	per Pound	Daily Cost	per Pound	Daily Cost	per Pound
Pounds output per day	11,765		10,000		8,000	
Raw material procurement	$ 68	$0.0058	$ 68	$0.0068	$ 68	$0.0085
Direct labor cost	2,285	0.1942	2,178	0.2178	2,052	0.2565
Manufacturing Expense	1,801	0.1531	1,635	0.1635	1,447	0.1809
Packaging supplies and expenses	1,106	0.0940	940	0.0940	752	0.0940
Other manufacturing expenses	695	0.0591	695	0.0695	695	0.0869
General and Administration	260	0.0221	260	0.0260	260	0.0325
Total	$4,414	$0.3752	$4,141	$0.4141	$3,827	$0.4784

Table III -- Processing Cost Summary for Cabbage Dehydration Plant

Account No.	Table No. Reference	Processing Cost: Per 24-hour Operating Day	Processing Cost: Per Pound Dry Product
Output of Finished Product Per Day . . . . . . (20 to 1 overall shrinkage ratio)	II	10,000 pounds	
800 -- Total Cost of Finished Product . . . . . (exclusive of depreciation and raw material purchase price)		$4,141	$0.4141
100 -- Raw Material Cost . . . . (exclusive of purchase price)	IV	$ 68	$0.0068
120 - Buying Expense		38	0.0038
180 - Federal-State Inspection		30	0.0030
200 -- Direct Labor	V	$2,178	$0.2178
210 - Raw Material Handling		146	0.0146
220-230 - Preparing		865	0.0865
240 - Drying		537	0.0537
250 - Inspecting		197	0.0197
260 - Packaging and Packing		374	0.0374
270 - Warehousing and Shipping		59	0.0059
300 -- Manufacturing Expense		$1,635	$0.1635
310 - Indirect Labor	VII	166	0.0166
320 - Utilities	VIII	206	0.0206
330 - Maintenance and Repairs	IX	137	0.0137
340 - Depreciation (not included)	X	---	------
350 - Taxes and Insurance	XI	44	0.0044
370 - Packing Supplies and Expenses	XII	940	0.0940
380 - Inspection and Control	XIII	72	0.0072
390 - Miscellaneous Plant Expenses	XIV	70	0.0070
600 -- General & Administrative Expenses . . .	XV	$ 260	$0.0260
610 - Office Salaries		127	0.0127
620-690 - Miscellaneous Expenses		133	0.0133

Table IV -- Raw Material Cost (Account 100)
(Cabbage Dehydration Plant)

Account No.			Annual Cost	Cost per Operating Day 1/
100 -- Total Raw Material Cost (excluding purchase price of raw material)			$16,956	$68
110 - Purchase Price			-----	---
	The purchase price of raw material is not included here as a cost. See Table I for calculation of raw material costs at various purchase prices per ton			
120 - Buying Expenses			9,456	38
	Salary of field agent	$7,000		
	Social security, workmen's compensation and unemployment insurance - 6.52%	456		
	Expenses - Travel, telephone, etc. (estimated)	2,000		
150 - Transportation and Weighing Costs			-----	---
	(Included in Table I as part of assumed prices paid for raw material)			
160 - Storage - None			-----	---
	(Cabbage should be processed immediately without storing outside of plant)			
170 - Crate, Box, and Sack Expense - None			-----	---
	Cabbage will be hauled in bulk			
180 - Federal-State Inspection			7,500	30
	One inspector 250 days @ $30.00			

1/ 250 working days a year.

Table V -- Direct Labor Cost Summary (Account 200)
(Cabbage Dehydration Plant)

Account No.		Per 24-Hour Operating Day: Direct Labor Cost per Day 1/	Add Labor Expense 22.25% 2/	Total Direct Labor Cost
200	-- Total Direct Labor Cost	$1,781	$397	$2,178
210	- Raw Material Handling	119	27	146
220-230	- Preparing	708	157	865
240	- Drying	439	98	537
250	- Inspecting	161	36	197
260	- Packaging and Packing	306	68	374
270	- Warehousing and Shipping	48	11	59

1/ From Table VI

2/ In addition to the "Direct Labor Cost per Day" the following items are additional costs that must be paid by the employer:

		Percentage to apply to Calculated Labor Cost
a.	Overtime - All hours per week over 40 are paid for at one-and-one-half times the basic rate. The work week is 48 hours, making 8 hours to be paid at overtime. For the week he gets 52 hours pay for 48 hours work (52/48) - 1.0 = 0.08333	8.33%
b.	Swing and night shift differential may amount to 5¢/hr. At an average hourly labor rate of $1.28, the differential is 3.90% on two shifts, or an average of 2.60% on a three shift basis	2.60
c.	Social security - paid by employer	1.50
d.	Unemployment insurance - for a new, highly seasonal business, the rate would be	2.70
e.	Workmen's compensation insurance	2.32
f.	Vacation pay - one week's pay for employees who work over 1600 hours 6/250	2.40
g.	Holiday pay - 6 holidays estimated 6/250	2.40
	Total	22.25%

Table VI -- Direct Labor Cost Work Sheet (Account 200)
(Cabbage Dehydration Plant)

Account No.	Operation	Number of Employees per Shift: Men	Number of Employees per Shift: Women	Hourly Rate of Pay: Pay Bracket	Hourly Rate of Pay: Amount	Total Hours per Shift	Total Cost per Shift	Total Cost per 24-Hour Operating Day
200	-- TOTAL DIRECT LABOR COST	25	38				$593.81	$1,781.44
210	-- Raw Material Handling	3 1/2	-				$ 39.76	$ 119.28
	Foreman 1/	1/2		1	$1.90	4	7.60	
	Unloading	1		5	1.34	8	10.72	
	Feeding to preparation line	2		5	1.34	16	21.44	
220--	Preparing	3	21				235.92	707.76
230	Foreman 1/	1/2		1	1.90	4	7.60	
	Floorlady		1	5	1.34	8	10.72	
	Halving cabbage		8	6	1.18	64	75.52	
	Coring cabbage		8	6	1.18	64	75.52	
	Trimming cabbage		4	6	1.18	32	37.76	
	Shredding cabbage and loading trays 2/	1/2		4	1.42	4	5.68	
	Blanching and sulfiting	1		3	1.55	8	12.40	
	Cleaning up	1		5	1.34	8	10.72	
240	-- Drying	11 1/2	8					439.36
241	-- Tunnel drying	10	8					379.36
	Foreman 3/	1/2		1	1.90	4	7.60	
	Loading trays, operating shredder 2/	1/2		4	1.42	4	5.68	
	Feeding trays to tray loader		2	6	1.18	16	18.88	
	Spreading cabbage on trays		2	6	1.18	16	18.88	
	Tray stacking and truck weighing	1		4	1.42	8	11.36	
	Operating tunnels	2		4	1.42	16	22.72	
	Scraping trays		2	6	1.18	16	18.88	
	Restacking trays		2	6	1.18	16	18.88	
	Sub-total	4	8				122.88	368.64
	Sundays only - 1/18 cost to each shift							
	Washing trays	5		5	1.34	40	53.60	
	Repairing trays	1		5	1.34	8	10.72	
	Sub-total - Sundays only	6					64.32	10.72
248	-- Bin drying	1 1/2	-				20.00	60.00
	Foreman 3/	1/2		1	1.90	4	7.60	
	Loading, moving, and unloading bins	1		3	1.55	8	12.40	
250	-- Inspecting	1 3/4	3 1/2				53.56	160.68
	Foreman 4/	1/4		1	1.90	2	3.80	
	Floorlady 5/		1/2	5	1.34	4	5.36	
	Feeding (regulating flow to inspection belt)	1		5	1.34	8	10.72	
	Inspecting		3	6	1.18	24	28.32	
	Cleaning up	1/2		5	1.34	4	5.36	
260	-- Packaging and Packing	4	5 1/2				101.92	305.76
	Foreman 4/	1/2		1	1.90	4	7.60	
	Floorlady 5/		1/2	5	1.34	4	5.36	
	Feeding empty cans and collars to line		1	6	1.18	8	9.44	
	Filling and weighing		1	6	1.18	8	9.44	
	Compressing, adding recipes, removing collars		1	6	1.18	8	9.44	
	Sealing and traying for gassing		1	6	1.18	8	9.44	
	Vacuumizing and gassing	1		3	1.55	8	12.40	
	Soldering hole in lid and casing		1	5	1.34	8	10.72	
	Case opening (forming cases, adding sleeves, case branding)	1		4	1.42	8	11.36	
	Strapping and stacking cases	1		4	1.42	8	11.36	
	Cleaning up	1/2		5	1.34	4	5.36	
270	-- Warehousing and Shipping	1 1/4	-				16.20	48.60
	Foreman 4/	1/4		1	1.90	2	3.80	
	Storing, car loading, operating lift truck	1		3	1.55	8	12.40	

1/ One foreman for both raw material handling and preparing
2/ One operator for both shredding and tray loading operation
3/ One foreman for all drying operations
4/ One foreman for inspecting, packaging, and warehousing & shipping
5/ One floorlady for inspecting and packaging

Table VII -- Indirect Labor (Account 310)
(Cabbage Dehydration Plant)

Account No.	Number of Employ-ees	Assumed Yearly Rate	Hourly Rate	Total No. of Hours Employed Annually 1/		Yearly Cost	Cost per Operating Day
310 -- Total Indirect Labor						$41,450	$166
Year-round employees						$28,760	
Production Supt.	1	$7,000	-	-	$7,000		
Shift Superintendents	2	6,000	-	-	12,000		
Guards	---	------	-	-	8,000 2/		
Labor expense - 6.52% 4/					1,760		
Seasonal employees						12,690	
Boiler operator and oiler	3		$1.73	6,000 3/	10,380		
Labor expense - 22.25% 5/					2,310		

1/ 250 days a year

2/ The estimate of $8,000 for guard service is based upon an assumption of 16 hours guard service per day for each day of the year. The number of guards actually employed will depend upon how the guard time is divided among the guards. For example, in a week of 7 days, 16 hours a day, or a total of 112 hours, three guards could divide the time so that each would work about 37 hours.

3/ 250 days, 24 hours a day - 6,000 hours

4/

Social security	1.50%
Unemployment insurance	2.70
Workmen's compensation	2.32
	6.52%

5/ See Table V for analysis of 22.25% labor expense

Table VIII -- Utilities (Account 320)
(Cabbage Dehydration Plant)

Account no.		Cost/Operating Day
320	-- Total Daily Cost of Utilities	$206
321	-- Water supply	---
	100 gallons a minute is estimated need of plant. It is assumed water will be pumped from company's own well, so cost of pumping is included in power cost	
322	-- Fuel - Gas	160
323	-- Electric power	46
325	-- Waste disposal	---

322 -- Fuel - Gas

		B.T.U. per hour	Cu.ft. per day
Boiler: $\frac{75\% \text{ use factor} \times 150 \text{ boiler horsepower} \times 33{,}500 \text{ B.T.U.} \times 24}{80\% \text{ efficiency} \times 1{,}000 \text{ B.T.U./cu.ft.}}$	=		113,000
Drying Tunnels 1/			
Secondary: $\frac{30{,}000 \text{ c.f.m.} \times 60(145°-60°) \times .24}{15 \text{ cu.ft. per pound}}$	=	2,450,000	
Primary: $\frac{50{,}000 \text{ c.f.m.} \times 60(180°-120°) \times .24}{15 \text{ cu.ft. per pound}}$	-	2,880,000	
Heat per double tunnel		5,330,000	
Heat for 3 double tunnels		15,990,000	
Add 10% for losses		1,599,000	
Total B.T.U.'s required per hour		17,589,000	
Gas requirement -- 24-hour day		422,136,000	422,136
Total gas requirement per day			535,136
At 30¢ per 1,000 cu.ft. the cost is		$160	

323 -- Electric power

	K.W.
Motors - 262 h.p. (746 watts per h.p. and 75% use and efficiency factor)	147
Lights (estimated)	31
Heating lamps	12
Total electric power	190
Cost per hour @ 1/ per k.w.h.	$1.90
Cost per 24-hour day	$46

325 -- Waste disposal

Garbage disposal - No cost. Cabbage trimmings should have a good demand as stock feed, so farmers would haul trimmings away at no cost to plant

Sewage charges - None. Assumed disposal in rural area

1/ 50,000 c.f.m. of air made up from 30,000 c.f.m. from secondary tunnel, and 20,000 c.f.m. recirculated in primary tunnels

Table IX -- Maintenance and Repairs (Account 330)
(Cabbage Dehydration Plant)

	Total No. of Employees	Hourly Rate Pay Bracket	Hourly Rate Amount	Hours Worked Process Season 1/	Hours Worked Off Season 2/	Total per Employee	Hours for Group	Total Cost Per Year
Labor 3/								
Head mechanic	1	1	$1.90	2,000	400	2,400	2,400	$ 4,560
Shift mechanic and oilers	3	2	1.73	2,000	400	2,400	7,200	12,456
Maintenance mechanic	1	3	1.55	2,000	400	2,400	2,400	3,720
Sub-total	5							$20,736
Add labor expense - 16.43% 4/								3,407
Labor Cost								$24,143
Cost of Supplies and Replacements								
Estimated (for entire year)								10,000
Total Cost of "Maintenance and Repairs" for a year								$34,143
Cost per operating day (34,143/250) $137								

1/ 250 days - 8 hours a day = 2,000 hours

2/ 10 weeks - 50 days - 8 hours a day = 400 hours (includes vacation and holiday pay)

3/ All mechanics will be employed in off-season on maintenance and repair work

4/ Labor expense during processing season 18.41%

Night shift differential: 2 mechanics out of 5 on night shift. At average hourly rate of $1.73, 5¢ an hour differential (2.90% x 2/5)	1.16%
Social security	1.50
Unemployment insurance	2.70
Workmen's compensation	2.32
Vacation pay (included in time for off-season)	----
Holiday pay (see Table V)	2.40
Overtime - 52 hours pay for 48 hours work (see Table V) .	8.33

Labor expense during off-season 6.52%

Social security	1.50%
Unemployment insurance	2.70
Workmen's compensation	2.32
Vacation and holiday pay included in regular 40-hour week	----

Calculation of labor expense percentage to apply:

(2,000 hours @ 18.41%) 2,000 x 0.1841 = 368.20

(400 hours @ 6.52%) 400 x 0.0652 = 26.08

394.28 $\frac{394.28}{2,400}$ = 16.43%

Table X -- Depreciation (Account 340)
(Cabbage Dehydration Plant)

Depreciation is not included as a cost because of the uncertainty of the write-off period that may be allowed. (See "Business Considerations" in Volume I.) The depreciation charges that would be incurred in this plant are calculated below for two possible write-off periods:

1. Assuming normal life expectancy and probable useful lives (as given in Bulletin F, U.S. Treasury Dept., Bureau of Internal Revenue)

Property Item	Original Cost 1/	Estimated 10% Salvage Value	Cost to be Depreciated	Useful Life (years)	Annual Depreciation Charge
Building and Grounds 2/	$160,000	$16,000	$144,000	50	$2,900
Equipment	274,870	27,490	247,380	15	16,500
Total	$434,870	$43,490	$391,380		$19,400

Depreciation Charges:

Per operating day ($19,400/250) $77.60

Per lb. of product at 17:1 ($77.60/11,765) $0.0066
Per lb. of product at 20:1 ($77.60/10,000) 0.0078
Per lb. of product at 25:1 ($77.60/ 8,000) 0.0097

2. Assuming 5-year write-off of 75% of capital investment

Total capital investment $434,870
75% to be written off $326,153

Annual charge ($326,153/5) . . . . $ 65,230

Depreciation Charges:

Per operating day ($65,230/250) $261.00

Per lb. of product at 17:1 ($261/11,765) $0.0222
Per lb. of product at 20:1 ($261/10,000) 0.0261
Per lb. of product at 25:1 ($261/ 8,000) 0.0326

1/ Includes Engineering Construction fees (Building and Grounds $5,000; Equipment $25,000)

2/ Includes value of land not depreciated

Table XI -- Taxes and Insurance (Account 350)
(Cabbage Dehydration Plant)

Account No.		Cost per Operating Day
350 -- Taxes and Insurance Expense		$44
For purposes of this estimate, taxes and insurance on property are combined.		
Estimated cost of facilities	$440,000	
Taxes and insurance at 2 1/2%	11,000	
Cost per operating day (11,000/250)	$44	

Table XII -- Packing Supplies and Expenses (Account 370)
(Cabbage Dehydration Plant)

Account No.	Cost per Operating Day
370 -- Total Packing Supplies and Expenses	$940
Cans	
Allowing 1 3/4 pounds cabbage per No. 10 can	
10,000 lbs. daily output/1.75 = 5,720 cans per day @ $99/M	$566
Cases	
954 per day (6 cans per case) @ $299.25/M	286
Supplies	
Straps, glue, recipe sheets, etc. @ 1¢ a can	57
Nitrogen - for gas pack 1,750 cu.ft. per day @ $1.25 per hundred cu.ft. ($1.00 per hundred cu.ft. for nitrogen .25 per hundred cu.ft. for freight and cylinder return)	22
Allowance for losses (1% of $931)	9

Table XIII -- Inspection and Control (Account 380)
(Cabbage Dehydration Plant)

Account No.			Annual Cost	Cost/Operating Day
380 -- Total Cost, Inspection and Control			$17,926	$72
	Salaried Employees:			
	Quality Control Technologist	$6,000		
	Add labor expense (6.52%)	391	$ 6,391	
	Hourly Employees:			
	3 laboratory technicians @ $1.30/hr. (6,000 hrs.)	$7,800		
	Labor expense (22.25%)	1,735	9,535	
	Supplies & Other Miscellaneous Expenses		2,000	

Table XIV -- Miscellaneous Plant Expenses & Income (Account 390)

Account No.	Cost/Operating Day
390 -- Miscellaneous Plant Expense	$70
391 - Lunch room operation - Assumed that sales of meals would offset the lunch room expense	---
392 - Chemicals - Sodium bisulfite, sodium sulfite, sodium carbonate - $1.00 an hour	20
393 - Sale of trimmings, fines, etc. Some return might be realized from the sale of trimmings, cores, "rejects," and "fines." This cost estimate does not assume any return from the sale of such material, although it possibly could be sold as feed	
394 - Other miscellaneous costs (estimated)	50

Table XV -- General and Administrative Expense (Account 600)

Account No.	Cost/Operating Day
Estimated at 4% of a production cost (of 65¢/lb.)	$260

(10,000 lbs x 65¢ x 4% = $260
Annual cost ($260 x 250) = ... $65,000

This estimate is consistent with World War II experience when dehydrators reported General and Administrative Expense ranging from 1% to 15% of total production cost, and averaging between 4% and 5%. This annual cost might be made up as follows:

610	- Salaries	General Manager	$10,000				
		Office manager	6,000				
		Personnel officer	4,800				
		Clerks (3 @ $3,000)	9,000	$29,800			
		Labor expense (6.52%)		1,940	$31,740		
620-690	- Other expenses				33,260	$65,000	

CHAPTER VI

SUMMARY OF CAPITAL AND CREDIT REQUIREMENTS FOR A 100-TON PER DAY CABBAGE DEHYDRATION PLANT

Fixed Capital and Credit Requirements:			
Plant Equipment		$250,000	
Buildings and Grounds		155,000	
Construction Engineering Fees		30,000	
6-Month General Expense: (From "Production Costs")			
From Table IV - Raw Material Procurement . .	$ 4,700		
From Table XIII - Inspection & Control . .	8,800		
From Table XV - General Administration	32,500	46,000	$481,000
Operating Capital and Credit Requirements:			
Estimated Advance Payments to Growers, Insurance, Utilities, etc. . .		$ 25,000	
75-day Operating Costs ($6,500/operating day) 1/		487,500	
25-day Inventory of Manufacturing Supplies (exclusive of raw commodity) ($940/operating day)		23,500	536,000
Sub-total			$1,017,000
General Contingency Fund:			
Equivalent to approximately 10% of Estimated Capital Requirements			100,000
ESTIMATED TOTAL CAPITAL AND CREDIT REQUIREMENTS			$1,117,000

1/ Based on 10,000 lbs. dehydrated cabbage shreds per day at an approximate cost of 65¢/lb.

FIG. I USUAL PLANTING AND HARVESTING PERIODS FOR CABBAGE IN PRINCIPAL PRODUCING STATES.

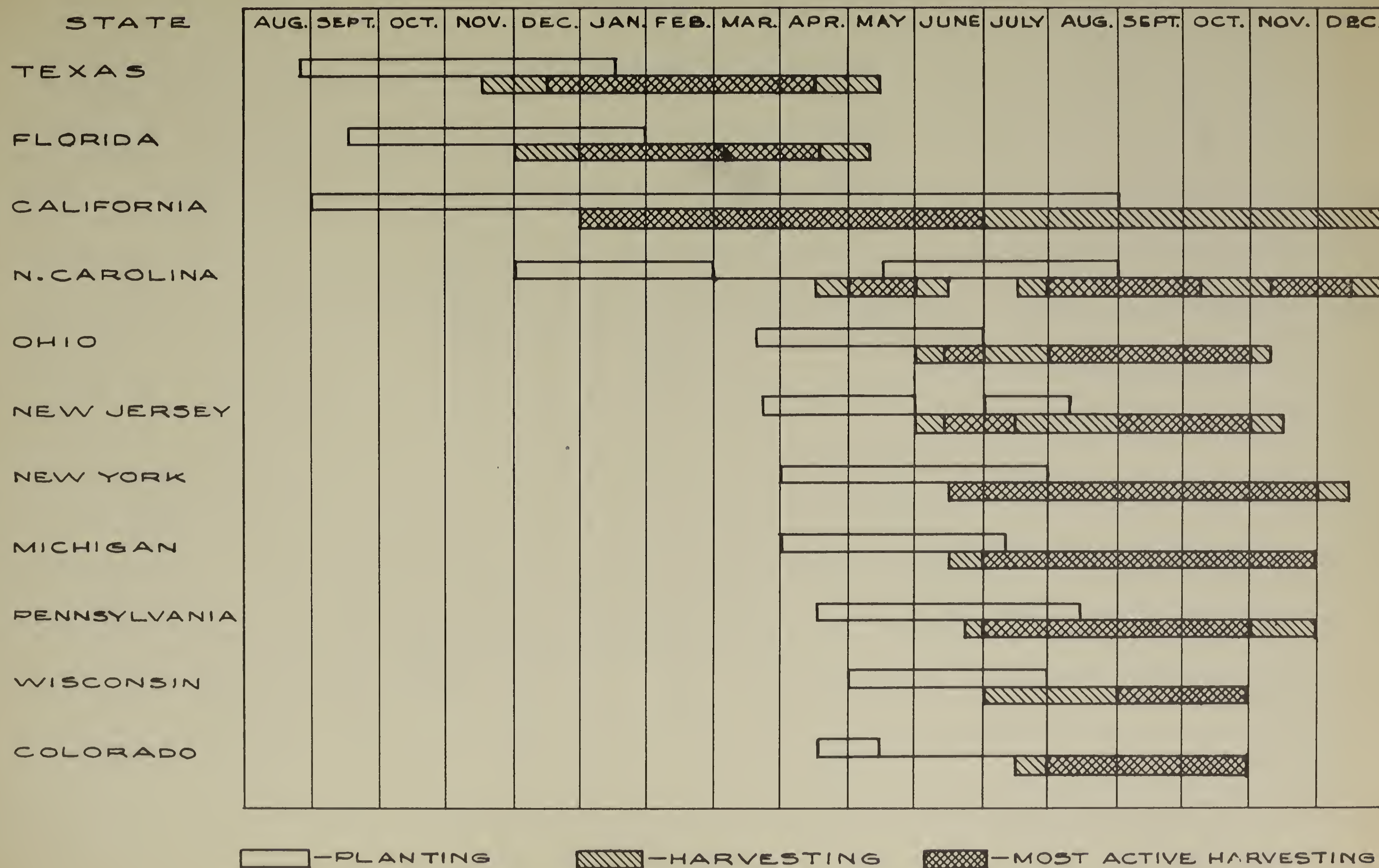
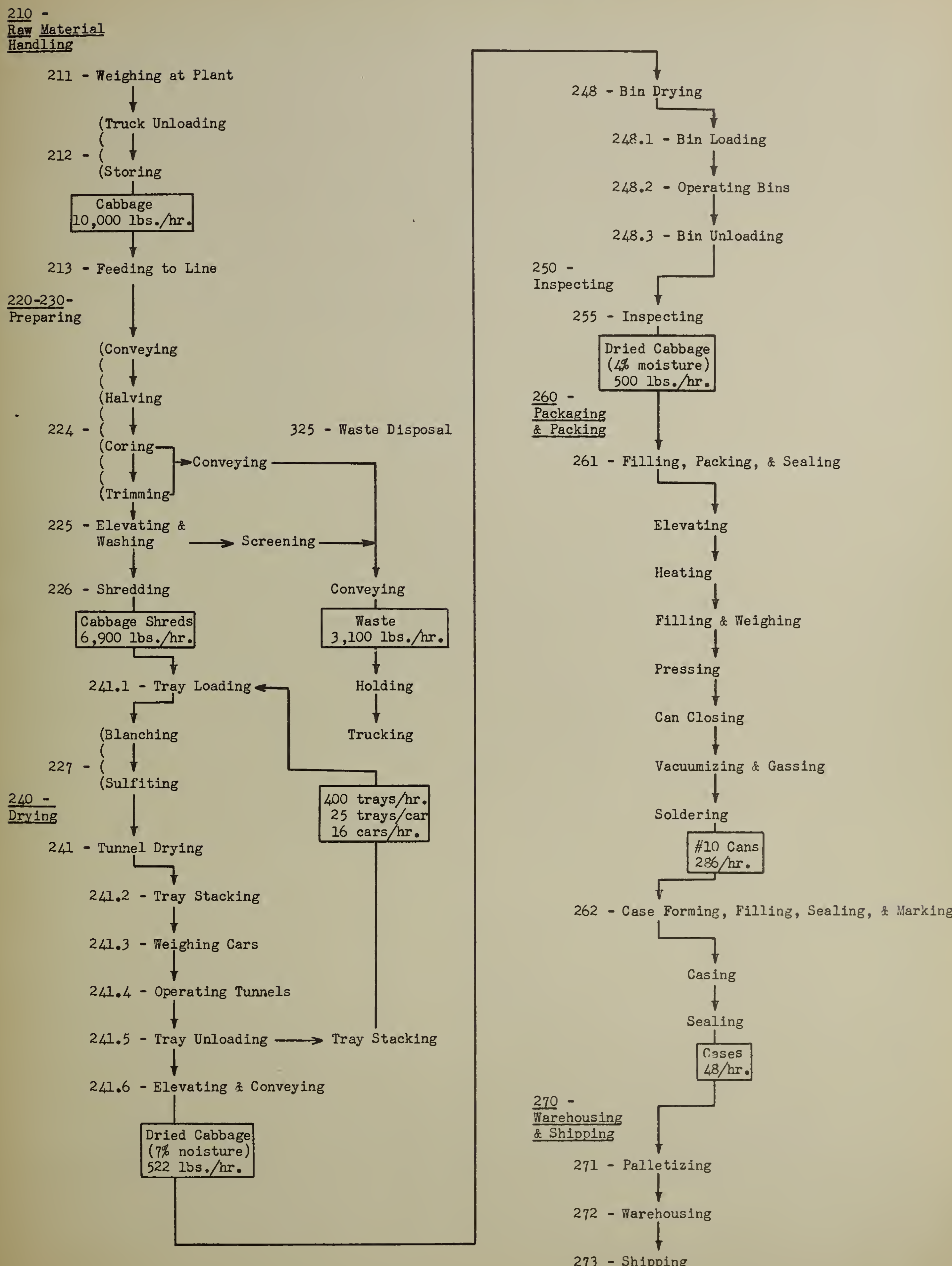


Figure 2 - FLOW SHEET FOR CABBAGE DEHYDRATION
(Capacity - 100 Raw Tons per Day)



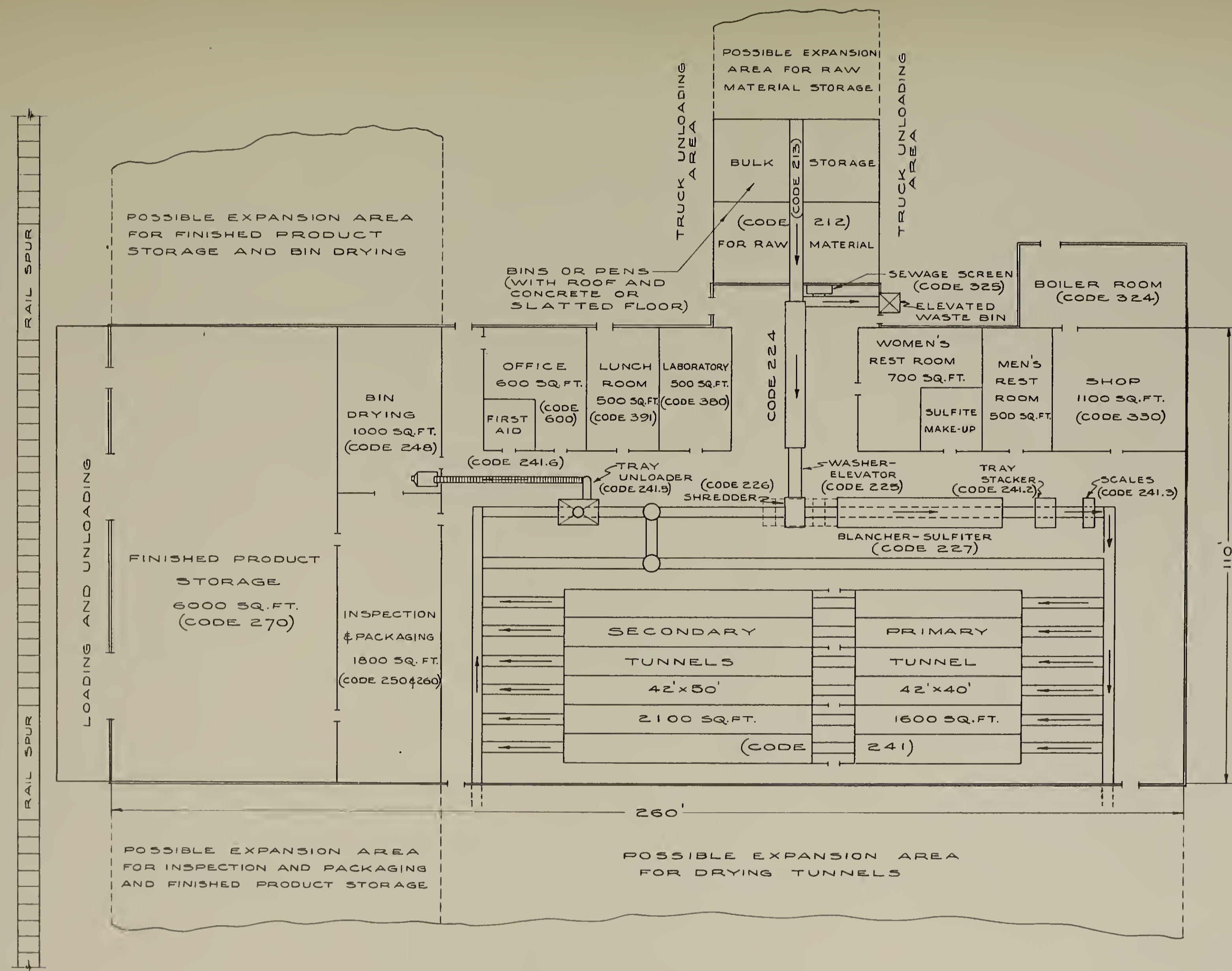
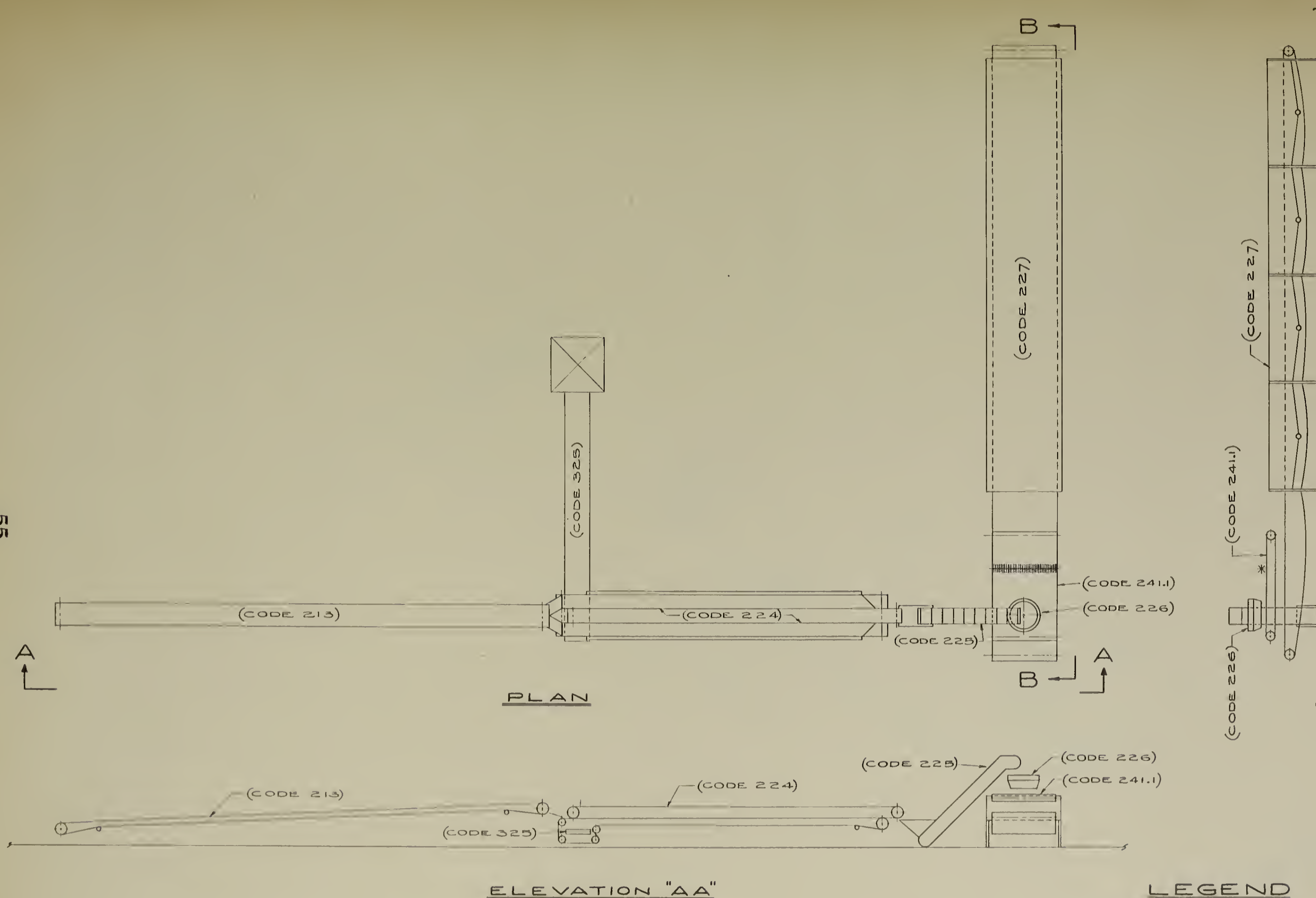


FIGURE 3

PROPOSED FLOOR PLAN FOR CABBAGE DEHYDRATION PLANT

AREA APPROXIMATELY 30,000 SQ. FT.

(EXCLUSIVE OF RAW MATERIAL STORAGE SPACE)



LEGEND

CODE 213	CONVEYOR
224	HALVING, CORING AND TRIMMING TABLE
225	ELEVATOR-WASHER
226	SHREDDER
227	BLANCHER-SULFITER
241.1	TRAY LOADER
325	WASTE CONVEYOR AND HOPPER

FIGURE 4

PREPARATION LINE FOR CABBAGE DEHYDRATION.

GENERAL NOTES

1. DAMPER TO REGULATE FLOW OF FRESH AIR TO SECOND STAGE
2. COMBUSTION CHAMBER FOR SECOND STAGE
3. BLOWER FOR SECOND STAGE
4. SHUT-OFF DAMPERS (TWO)
5. DAMPER TO REGULATE FLOW OF FRESH AIR TO PRIMARY STAGE
6. COMBUSTION CHAMBER FOR PRIMARY STAGE
7. BLOWER FOR PRIMARY STAGE
8. SHUT-OFF DAMPERS (TWO)
9. DAMPERS TO REGULATE FLOW OF RECIRCULATING AIR (TWO)
10. EXHAUST STACKS (TWO)
11. OVERHEAD SLIDING DOORS (TWO)
12. ACCESS DOORS (TWO)
13. ENTRANCE AND EXIT DOORS (4 SETS)
14. TRAYS OF RAW COMMODITY READY FOR DRYING (ON TRUCKS)
15. TRACKS THROUGH TUNNELS FOR TRUCKS
16. SPLITTER DAMPERS (TWO)

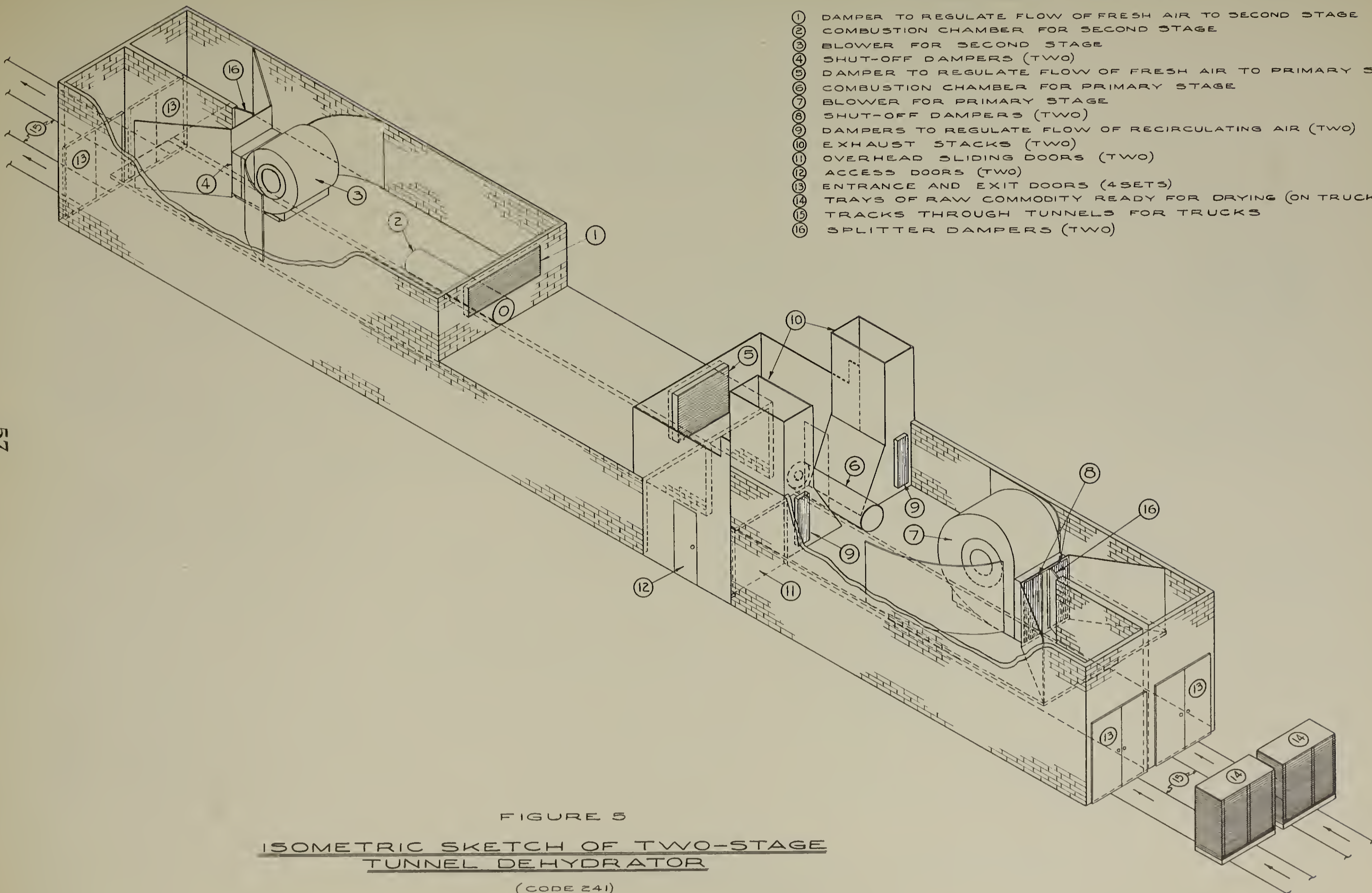
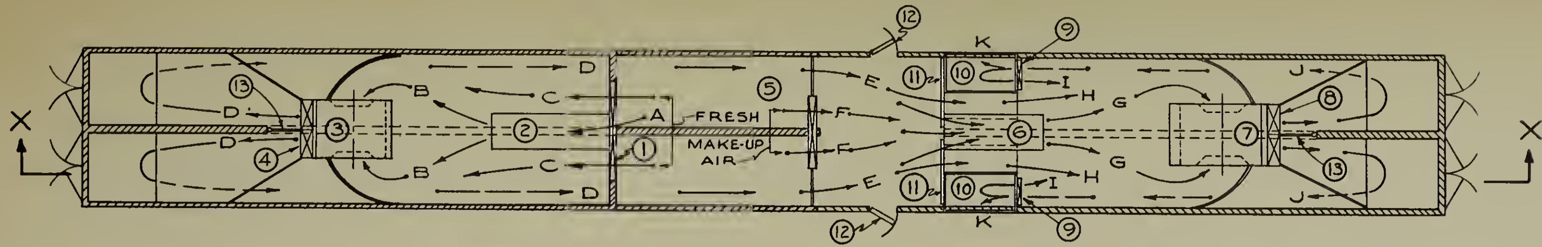


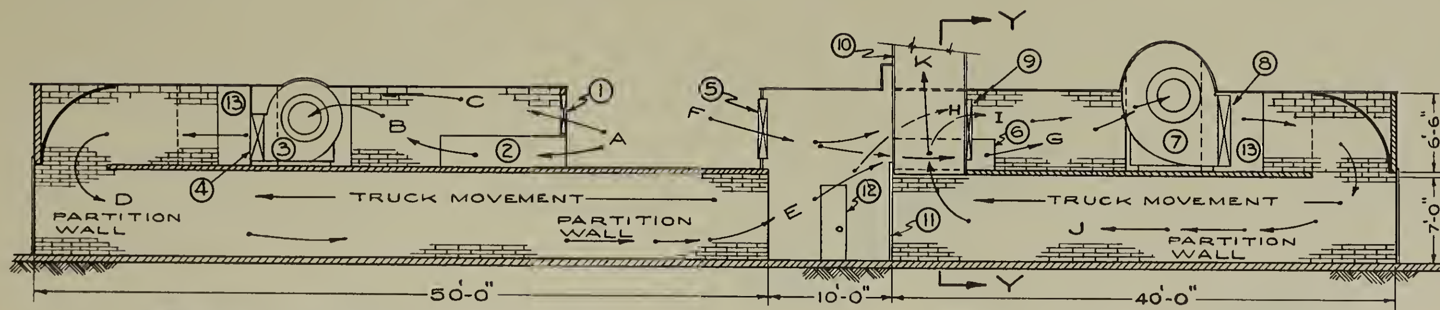
FIGURE 5

ISOMETRIC SKETCH OF TWO-STAGE TUNNEL DEHYDRATOR

(CODE 241)



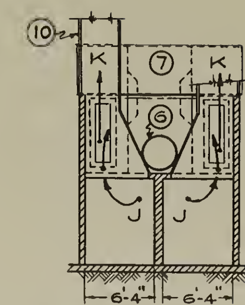
PLAN BELOW ROOF LINE



SECONDARY STAGE

PRIMARY STAGE

SIDE ELEVATION – SECTION "XX"



SECTION "YY"

GENERAL NOTES.

(1) DAMPER TO REGULATE FLOW OF FRESH AIR TO SECOND STAGE
(2) COMBUSTION CHAMBER FOR SECOND STAGE – 4,000,000 BTU/HR.
(3) BLOWER, FOR SECOND STAGE - ACCEPTABLE MODEL STURTEVANT SILENTVANE FAN, DESIGN 10, CLASS I, SIZE 95, DWDI, 20 HP. MOTOR
(4) SHUT-OFF DAMPERS (TWO)
(5) DAMPER TO REGULATE FLOW OF FRESH AIR TO PRIMARY STAGE
(6) COMBUSTION CHAMBER FOR PRIMARY STAGE – 6,000,000 BTU/HR.
(7) BLOWER FOR PRIMARY STAGE – ACCEPTABLE MODEL STURTEVANT SILENTVANE FAN, DESIGN 10, CLASS I, SIZE 115, DWDI, 40 H.P. MOTOR
(8) SHUT-OFF DAMPERS (TWO)
(9) DAMPERS TO REGULATE FLOW OF RECIRCULATING AIR (TWO)
(10) EXHAUST STACKS (TWO)
(11) OVERHEAD SLIDING DOORS (TWO)
(12) ACCESS DOORS (TWO)
(13) SPLITTER DAMPERS (TWO)

AIR FLOW NOTES.

A – FRESH MAKE-UP AIR TO SECOND STAGE
B – HOT AIR FROM SECOND STAGE COMBUSTION CHAMBER
C – FRESH MAKE-UP AIR BY-PASSING SECOND STAGE COMBUSTION CHAMBER
D – CONTROLLED TEMPERATURE, SECOND STAGE DRYING AIR.
E – EXHAUST AIR FROM SECOND STAGE
F – FRESH MAKE-UP AIR TO PRIMARY STAGE
G – HOT AIR FROM PRIMARY STAGE COMBUSTION CHAMBER – MIXTURE OF FRESH MAKE-UP AIR AND EXHAUST AIR FROM SECOND STAGE
H – AIR BY-PASSING PRIMARY STAGE COMBUSTION CHAMBER – MIXTURE OF FRESH AIR AND EXHAUST AIR FROM SECOND STAGE
I – RECIRCULATED AIR FROM TUNNEL EXHAUST
J – CONTROLLED TEMPERATURE, PRIMARY STAGE DRYING AIR
K – EXHAUST AIR FROM TUNNEL, TO OUTSIDE

FIGURE 6

TWO-STAGE TUNNEL DEHYDRATOR FOR CABBAGE

(CODE 241)

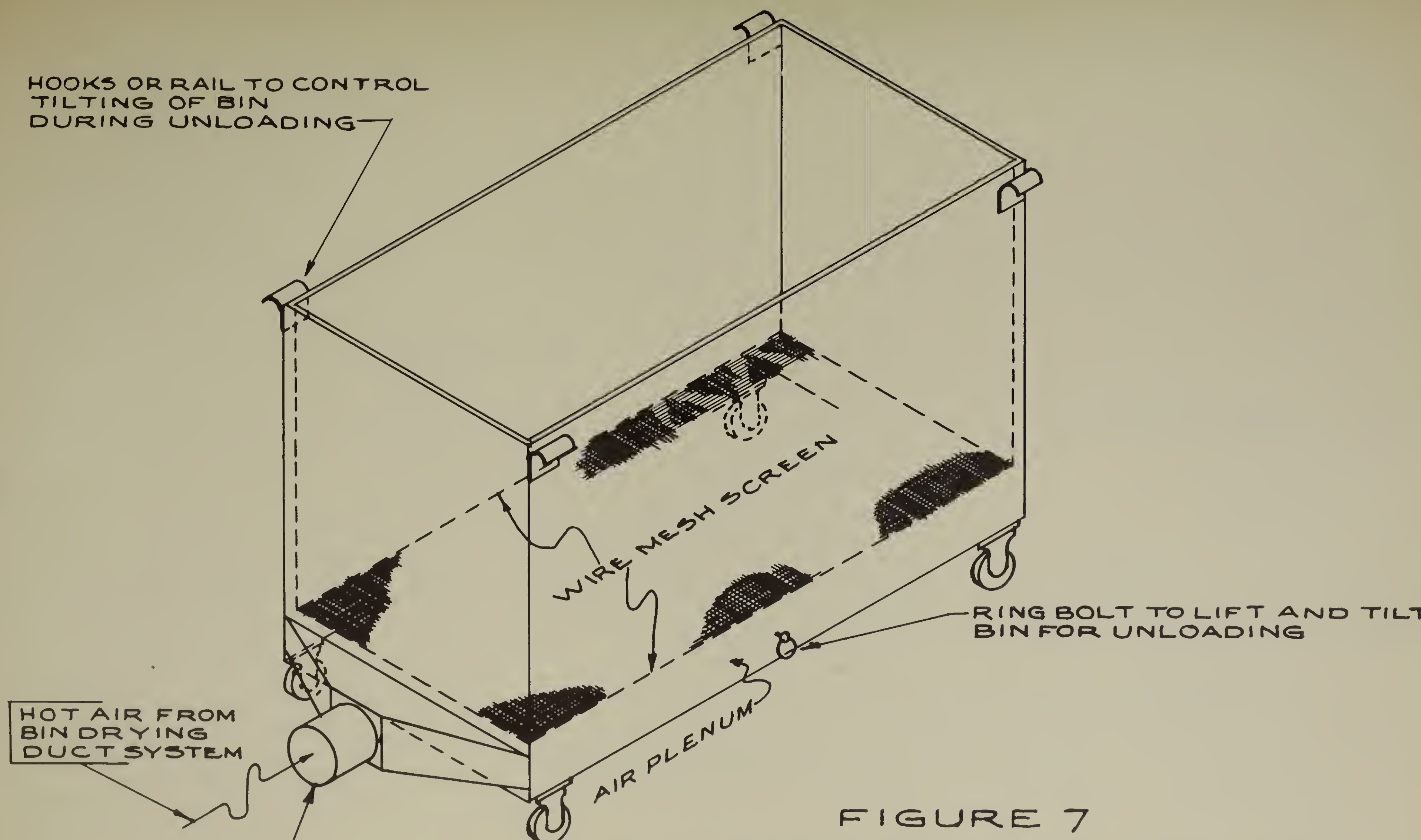


FIGURE 7

DIAGRAMMATIC SKETCH OF PORTABLE BIN FINISHER

(CODE 248.1)

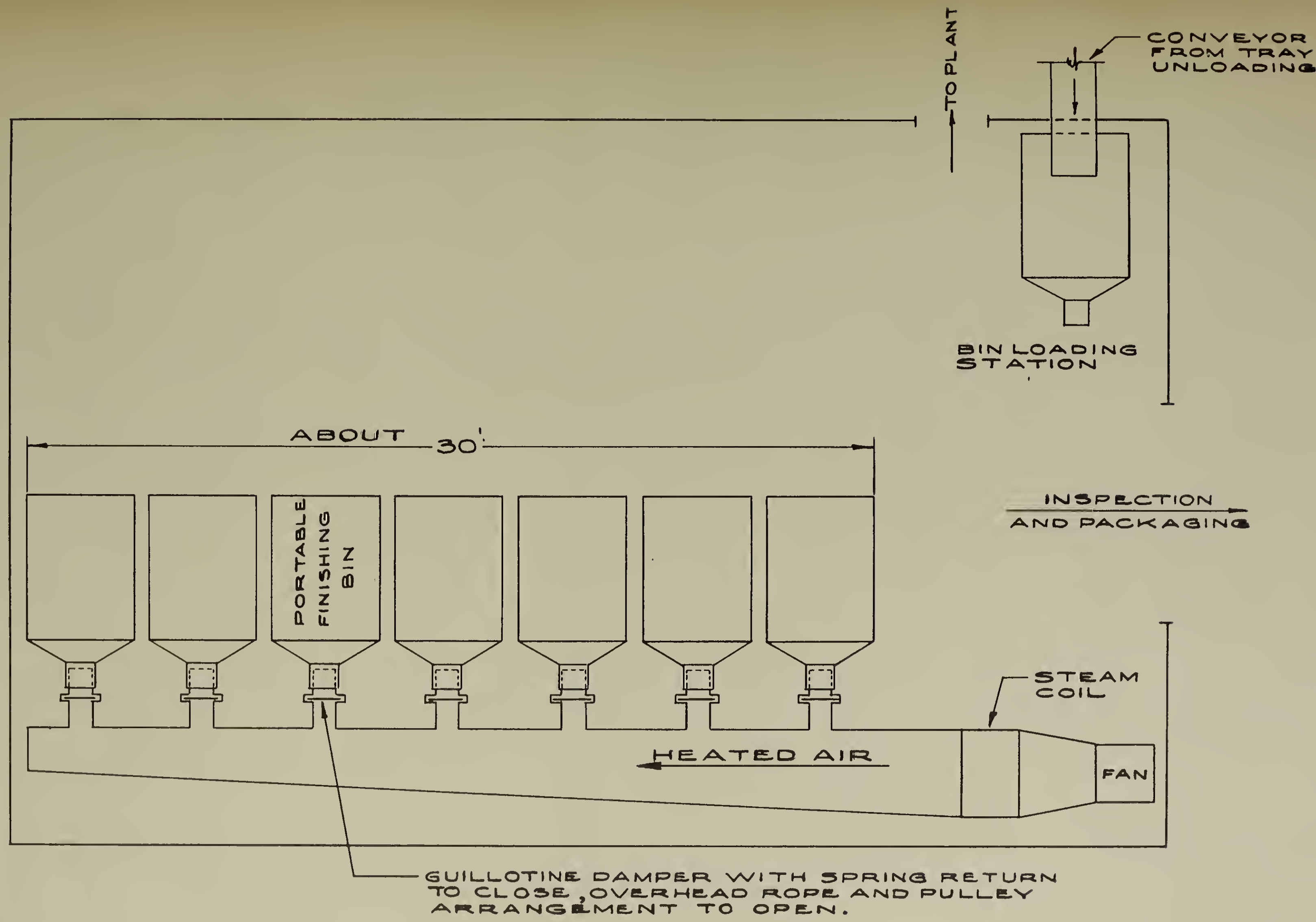


FIGURE 8

LAYOUT OF BIN FINISHING ROOM FOR CABBAGE DEHYDRATION PLANT.

(CODE 248)

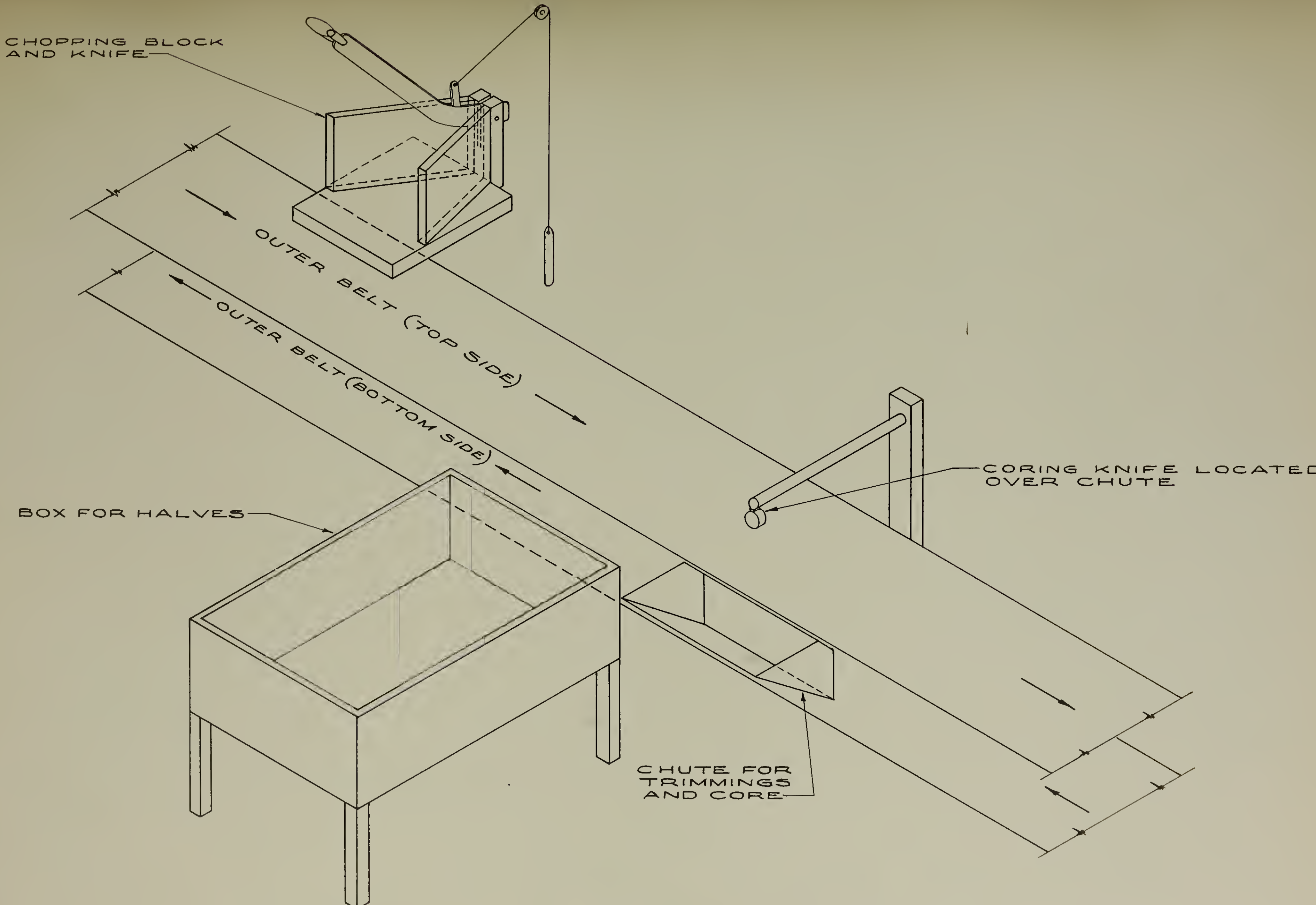


FIGURE 9

ISOMETRIC SKETCH OF CABBAGE HALVING & CORING LINE

(CODE 224)

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